5-3810-294-34

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

CRANE, TRUCK MOUNTED, 3/4 CU. YDS., 20 TON, W/CLAMSHELL, DRAGLINE AND BACKHOE ATTACHMENTS, G.E.D., (HARNISHFEGER MODEL M320T2)

FSN 3810-151-4431

This copy is a reprint which includes current pages from Changes 1 and 2

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1971

D 101.11:

READEX FICHE best copy available

SAFETY PRECAUTIONS

BEFORE OPERATION

Make certain that the crane and carrier have been deprocessed completely before servicing. Make certain that preservatives have been removed from crankcase, fuel tanks, gearcases, machines surfaces, and the like.

Fasten a tag near the radiator filler cap indicating the type antifreeze.

Before reeving any line, layout the line so that there is no possibility of kinking during the reeving process.

To install the boom, a cribbing will be necessary to support the boom in a horizontal position. The cribbing must be high enough to bring the boom into position with the boom foot lugs on the revolving frame.

Where there is no interference with machine operation, mount the tagline winder with the cable drum on the side away from the operator, to reduce interference with the operator's vision.

If there is tension on the tagline, do not release the tagline suddenly; to do so may cause damage to the tagline winder.

When inserting the cable end back into the cable socket, do not let it protrude on the opposite side more than one inch.

To install the backhoe boom, a cribbing will be necessary to support the boom in a horizontal position. The cribbing must be high enough to bring the boom into position with the boom foot lugs on the revolving frame.

Personnel should use care to keep from spilling fuel, coolant, or other liquids upon themselves. Exposed parts of the body should not come into contact with metal during cold weather, as serious and painful injury may result.

Do not use an open flame as the source of heat.

Turn radiator cap slowly and allow pressure to escape before removing it.

Always lower the attachment to the ground before attempting to adjust the boom hoist brake. Serious damage to the equipment or injury to personnel may otherwise result.

Always disconnect battery cables before working on electrical components.

Always replace points, and condenser at the same time spark plugs are replaced.

Disconnect battery cable at battery box before removing control panel.

A properly grooved sheave has smooth side walls and the groove is only slightly wider than the cable. Use a light layer of lubricant when reinstalling pins, bushings, and other fitter parts. Be sure lubrication fittings are properly installed and line up with grease holes.

When refueling the model M320T2 truck crane, always provide a metal to metal contact between the filler nozzle and the gasoline tank. This will prevent sparks which might ignite fuel, and will thus prevent an unsafe condition which might destroy the machine or injure personnel

Be sure that the filter element is over the reservoir inlet port.

Air in the tire can cause serious injury to personnel attempting to remove tires from wheels.

It is very important that all rust, corrosion, and accumulated dirt be removed from the ring and its seating surface on the wheel rim.

Always inflate the tire from the side opposite the ring. If the ring is improperly installed, air pressure may cause it to fly off the wheel, and serious injury to personnel may result.

DURING OPERATION

Proceed slowly and carefully when removing or installing the counterweight, since severe damage can be caused by improper handling.

The tagline winder should be left on the boom when not in use.

For moves over straight, open road, the shovel or backhoe may be moved with the dipper stick and boom over the rear of the carrier. Faced this way, the boom can be quite low and the unit can be moved with speed and safety.

Do not transport the truck crane with the piledriver front-end attachment installed.

Use care when swinging the revolving frame without a boom, since it will tend to be unbalanced toward the counterweight end.

Do not rely on the ratchet brake locks on the front or rear drum brake pedals to suspend a load. The operator must remain in a position of readiness, with feet on pedals, at all times that a load is suspended.

The boom hoist pawl must be engaged at all times, except when lowering the boom. Do not attempt to engage the boom hoist pawl while lowering the boom.

The front drum pawl must be engaged while suspending a load. Do not attempt to engage this pawl while lowering a load.

The rear drum pawl must be engaged while suspending a load on the rear drum line. Do not attempt to engage this pawl while lowering a load.

Do not crank engine for more than 30 seconds continuously without allowing a 2-minute cooling period. If engine does not start after a few tries, stop cranking. Determine the cause and correct.

Do not attempt to raise the boom by means of the boom hoist lines if the boom tip is below the ground level which supports the carrier. The angle of pull on the boom will be such that the boom might collapse before it can be pulled into the operating position.

Check the engine frequently for overheating in high altitude operation.

The swing brake is not used to stop the revolving frame from swinging while the machine is in operation. It is solely to prevent revolving frame from turning while the machine is not in use, such as when it is being moved from place to place.

While in the park abort condition, the carrier will have no brakes. Always block the wheels so as to prevent truck crane motion before placing the machine in the park abort condition. Do not remove blocking until the carrier is returned to normal brake system operation.

Do not shift the transfer case while the carrier is in motion.

AFTER OPERATION

The boom hoist pawl must be engaged at all times, except when lowering the boom. Do not attempt to engage the boom hoist pawl while lowering the boom.

Personnel should use care to keep from spilling fuel, coolant, or other liquids upon themselves. Exposed parts of the body should not come into contact with metal during cold weather, as serious and painful injury may result.

Do not use an open flame as the source of heat.

Turn radiator cap slowly and allow pressure to escape before removing it.

The swing brake is not used to stop the revolving frame from swinging while the machine is in operation. It is used solely to prevent the revolving frame from turning while the machine is not in use, such as when it is being moved from place to place.

When refueling the model M320T2 truck crane, always provide a metal to metal contact between the filler nozzle and the gasoline tank. This will prevent sparks which might ignite fuel, and will thus prevent an unsafe condition which might destroy the machine or injure personnel.

Air in the tire can cause serious injury to personnel attempting to remove tires from wheels.

Always inflate the tire from the side opposite the ring. If the ring is improperly installed, air pressure may cause it to fly off the wheel, and serious injury to personnel may result.

Be sure no hydraulic fluid comes into contact with any brake or clutch band while performing any maintenance operation.

Change } No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C. *18 April 1973*

Direct Support and General Support Maintenance Manual
CRANE, TRUCK MOUNTED; 3/4-CU. YDS., 20-TON; W/CLAMSHELL, DRAGLINE, AND BACKHOE ATTACHMENTS, G.E.D. (HARNISCHFEGER MODEL M320T2)
FSN 3810-151-4431

TM 5-3810-294-34, 13 May 1971 is changed as follows:

Inside front cover. "SAFETY PRECAUTIONS:" are superseded by "WARNING" as follows:

WARNING
DEATH ON CONTACT OR SEVERE INJURY
may result if personnel fail to observe safety precaution

HIGH VOLTAGE
Refer to TB 385-101 before operating this machine
near high voltage lines.

FIRE HAZARD
When refueling truck-crane, provide metal-to-metal
contact between filler nozzle and gasoline tank.
This will prevent sparks which might ignite fuel
and result in serious injury or death to personnel
and destruction of equipment.

DANGEROUS STEAM AND AIR PRESSURE
Turn radiator cap slowly to allow pressure to
escape before removing cap.
Inflate tires from the side opposite the ring.
If ring is improperly installed, air pressure may
cause it to fly off the wheel and serious injury
to personnel may result.

Page 1-2. Paragraph 1-4*b*(3), spark plug gap, change "0.015" to read "0.029."

Page 2-1. Paragraph 2-3 and 2-4 are superseded.

2-3. General.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the model M320T2 truck crane. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor."

Pages 2-2 through 2-6. Table 2-1 is superseded.

Table 2-1. Troubleshooting.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

1. Engine Will Not Crank

Step 1. Test to determine if batteries are too low to turn over engine.
Charge or replace batteries.
Step 2. Check for faulty starter relay.
Replace relay (TM 5-3810-294-20).
Step 3. Check for faulty starter.
Repair starter (chap. 3 or 12).
Step 4. Check to determine if engine seized due to operation without proper lubricant or coolant.
Repair engine as required (chap. 4 or 13).

2. Engine Cranks But Will Not Start

Step 1. Check interior of distributor cap.
Dry interior of distributor cap; replace if defective. (Refer to TM 5-3810-294-20).
Step 2. Inspect for open primery ignition circuit.
Tighten leads, clean dirty points, replace defective points and repair open ignition switch circuit. (Refer to TM 5-3810-294-20).
Step 3. Inspect for grounded primery ignition switch.
Replace lead if insulator is cracked. Adjust ignition points. Replace grounded capacitor. (Refer to TM 5-3810-294-20).
Step 4. Inspect for faulty secondary ignition circuit.
Clean spark plug cable terminals, and/or replace broken or cracked cable insulation. Clean spark plugs, and replace if damaged. Replace a cracked distributor cap. Replace rotor if cracked or contact arm broken (Refer to TM 5-3810-294-20).
Step 5. Check conditions of batteries.
Replace defective batteries. (refer to TM 5-3810-294-20).
Step 6. Check valve tappet clearance.
Adjust valves. (Refer to TM 5-3810-294-20).
Step 7. Check fuel pump.
Replace defective fuel pump. (Refer to TM 5-3810-294-20).
Step 8. Check carburetor.
Adjust carburetor. (Refer to TM 5-3810-294-20). Repair faulty carburetor (Chap 3 or 12).
Step 9. Check compression pressure of cylinders.
If extremely low compression pressure on one or more cylinders, replace piston rings, pistons, or other engine parts as required (Chap 4 or 13).

3. Engine Idles Rough

Step 1. Check carburetor adjustment.
Adjust carburetor (Refer to TM 5-3810-294-20).
Step 2. Check ignition point gap.
Adjust points. (Refer to TM 5-3810-294-20).
Step 3. Check intake manifold for leaks.
Repair intake manifold. (Refer to TM 5-3810-294-20).
Step 4. Check valve tappet clearance.
Adjust tappets. (Refer to TM 5-3810-294-20).

4. Engine Noisy

Step 1. Check valve tappet clearance.
Adjust tappets. (Refer to TM 5-3810-294-20).
Note: Knocking, pounding or similar noises are serious. Locate the sound, and repair or replace the parts involved. Any unusual engine sound must be accounted for and corrected.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Check for worn or damaged bearings.
Repair or replace the bearings or other parts involved.

5. Engine Fails To Reach Operating Temperature

Step 1. Check for thermostat stuck open or removed from vehicle.
Replace thermostat. (Refer to TM 5-3810-294-20).

Step 2. Check for defective temperature sending unit or engine control panel gage.
Replace defective unit. (Refer to TM 5-3810-294-20).

6. Engine Overheats

Step 1. Check for loose water pump V-belt.
Adjust V-belt. (Refer to TM 5-3810-294-20).

Step 2. Check for faulty water pump.
Replace water pump. (Refer to TM 5-3810-294-20).

Step 3. Check for collapsed or clogged hoses.
Replace hoses. (Refer to TM 5-3810-294-20).

Step 4. Check for defective thermostat.
Replace thermostat. (Refer to TM 5-3810-294-20).

Step 5. Check radiator for leaks or clogging.
Repair or replace radiator (Sect. VII).

Step 6. Check engine for oil leaks at oil filter and at any external piping.
Replace leaky oil filter and/or piping.

Step 7. Check for excessive engine internal friction or excessive load on engine, due to excess friction in driven items, such as transmission.
Note: This is a serious condition which can be corrected only by overhaul of the item which is faulty.
Determine cause and overhaul the overheated binding assembly.

7. Low Oil Pressure

Step 1. Check engine oil level.
Add oil.

Step 2. Check for loose connections in oil lines.
Tighten oil line connections.

Step 3. Check for clogged oil filter.
Change oil filter. (Refer to TM 5-3810-294-20).

Step 4. Check to determine if oil is too thin due to dilution or too light a grade used.
Drain crankcase and refill with proper oil.

Step 5. Check for faulty oil pressure sender.
Replace oil pressure sender. (Refer to TM 5-3810-294-20).

Step 6. Check for worn main bearings, connecting rod bearings, or excessive clearance in other engine parts.
Repair engine as required (Chap 4 or 13).

8. High Oil Pressure

Step 1. Check to determine if oil is too heavy.
Drain crankcase and refill with proper oil.

Step 2. Check for defective oil pressure gage on engine control panel.
Replace oil pressure gage. (Refer to TM 5-3810-294-20).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

9. Excessive Oil Consumption

Step 1. Check oil lines for leaks.
Tighten loose connections.
Step 2. Check oil for poor quality or wrong grade.
Drain crankcase and refill with proper oil.
Step 3. Check for clogged oil pressure relief passage (causing back pressure in crankcase).
Clean oil pressure relief passage.
Step 4. Check for broken or worn valves, rings, pistons, or connecting rod bearings, or stuck valves. Check compression (Refer to TM 5-3810-294-20).
Repair or replace rings and/or valves as required. (Chap 4 or 13). Free valves and replace faulty valves, springs, or valve guides as required.

10. Engine Lacks Power

Step 1. Check fuel pump.
Replace defective fuel pump. (Refer to TM 5-3810-294-20).
Step 2. Check for dirty or faulty carburetor.
Clean, inspect and repair carburetor, (Sect IV). Replace defective carburetor (TM 5-3810-294-20).
Step 3. Check for faulty spark plugs.
Replace spark plugs (TM 5-3810-294-20).
Step 4. Check for burned, pitted, or sticking ignition points.
Replace points (TM 5-3810-294-20).
Step 5. Check for faulty ignition or timing.
Inspect and/or replace points, plugs, and other ignition components.
Step 6. Check for excessive load on engine.
Note: This is a serious condition which can be corrected only by overhaul of the item which is faulty.
Determine cause and overhaul the overheated binding assembly.
Step 7. Check for clutch slipping.
Adjust clutch (Refer to TM 5-3810-294-20). Replace clutch drive plate lining (Chap 14, Sect. III).
Step 8. Check for broken or worn valves or piston rings.
Check compression (TM 5-3810-294-20). Repair or replace rings and/or valves as required (Chap 4 or 13).
Step 9. Check for stuck valves (open or closed) in valve guides.
Free valves and replace faulty valves, springs, or valve guides as required (Chap 4 or 13).
Step 10. Check for improper fuel mixture.
Repair carburetor or fuel pump (Chap 3 or 12).

11. Engine "Cuts Out" Suddenly Under Load

Step 1. Check for restricted fuel line.
Replace fuel line (Refer to TM 5-3810-294-20).
Step 2. Check for faulty fuel pump.
Replace fuel pump (Refer to TM 5-3810-294-20).

12. Engine Tends To Stall at Fuel Load

Step 1. Check for faulty fuel pump.
Replace fuel pump (Refer to TM 5-3810-294-20).

MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

13. Engine Exhaust Is Smoky

Step 1. If exhaust is black, incomplete fuel combustion due to poor spark plugs or ignition timing is indicated.
  Replace spark plugs and adjust ignition timing. (Refer to TM 5-3810-294-20).

Step 2. If exhaust is blue, this indicates the engine is burning oil due to leaking oil into exhaust manifold or blow-by past piston rings.
  Repair engine as required (Chap 4 or 13).

14. Engine Overspeeds

Step 1. Check for incorrect engine speed governor adjustment.
  Adjust speed governor (Refer to TM 5-3810-294-20).

15. Engine Clutch Overheats or Jumps Out of Engagement

Step 1. Check for improper clutch adjustment.
  Adjust clutch (Refer to TM 5-3810-294-20).

Step 2. Check for worn clutch plates.
  Repair clutch (Chap 14).

16. Batteries Discharge With Engine Running

Step 1. Check for loose connection.
  Tighten connection.

Step 2. Check for loose alternator V-belt or faulty alternator.
  Adjust V-belt tension.
  Repair or replace faulty alternator (Chap 3).

Step 3. Check for worn brushes.
  Replace brushes (Chap 3).

Step 4. Check for alternator "single phasing" due to burned out rectifier or rectifiers.
  Repair or replace alternator (Chap 3).

17. Incorrect Alternator Voltage

Step 1. Check for faulty alternator.
  Replace alternator (Refer to TM 5-3810-294-20).

Step 2. Check for faulty voltmeter.
  Replace voltmeter (Refer to TM 5-3810-294-20).

18. Starter Does Not Rotate or Rotates Slowly

Step 1. If lights go out or dim, check for weak battery or poor connections.
  Refer to TM 5-3810-294-10 and/or TM 5-3810-294-20 and correct the battery problem.

Step 2. If lights stay bright, check for faulty starter switch.
  Replace starter components as necessary (Chap 3).

19. Starter Rotates But Does Not Engage Flywheel

Step 1. Check for stuck pinion, broken pinion teeth, or faulty solenoid.
  Repair and/or replace faulty item (Chap 3).

Step 2. Check for broken ring gear teeth.
  Replace ring gear (Chap 3).

20. Power Steering is "Spongy" and Makes "Groaning" Sound

Step 1. Check for low fluid level.
  Add fluid (refer to TM 5-3810-294-20).

MALFUNCTION
  TEST OR INSPECTION
    CORRECTIVE ACTION

Step 2. Check for faulty power steering pump.
    Replace pump (Refer to TM 5-3810-294-20).
Step 3. Check for mechanical linkage binding.
    Adjust or repair linkage (Chap 16).

21. Hard Steering When Vehicle is Standing, or When Trouble is Intermittent

Step 1. Check for low hydraulic fluid level.
    Add fluid (Refer to TM 5-3810-294-20).
Step 2. Check for loose or glazed pump belt.
    Adjust or replace belt (Refer to TM 5-3810-294-20).
Step 3. Check for worn tires, unbalanced wheels, wrong air pressure, out of alinement.
    Refer to TM 5-3810-294-10 and/or TM 5-3810-294-20 and correct the steering problem.

22. Hard Steering When Vehicle is Moving

Step 1. Check for clogged filter.
    Clean filter or replace reservoir (Refer to TM 5-3810-294-20).

23. Brakes "Grab" or Vehicle Tends to Turn When Brakes are Applied (Pulls to One Side)

Step 1. Check for improper brake adjustment.
    Adjust brakes (Refer to TM 5-3810-294-20).
Step 2. Check for worn brake linings.
    Replace brake shoes (Chap 18).

24. Incorrect Air Brake System Pressure

Step 1. Check for leaks in system.
    Tighten loose hose connections. Replace defective hose.
Step 2. Check for defective compressor.
    Replace compressor. (TM 5-3810-294-20).
Step 3. Check to determine if governor is set at wrong pressure ranges.
    Adjust governor (TM 5-3810-294-20).

25. Lights Fail or Dim

Step 1. Check for defective or burned out lamps.
    Replace lamps (TM 5-3810-294-20).
Step 2. Check for loose connections or defective wiring.
    Tighten connections. Repair and/or replace wiring.
Step 3. Check for defective switches.
    Replace switches (TM 5-3810-294-20).
Step 4. Check for faulty ground.
    Clean ground terminals.

26. Crane Will Not Lift Rated Capacity

Step 1. Check front and rear drum clutches for slipping.
    Adjust drum clutches (TM 5-3810-294-20).
Step 2. Check engine for lack of power.
    Perform procedures listed in malfunction 10, above.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

27. Boom Will Not Lower

Step 1. Check to determine if safety panel is engaged.
Lift boom slightly, disengage safety panel and lower boom.
Step 2. Check boom hoist panel friction shoes and linkage adjustment.
Adjust shoes and/or linkage (TM 5-3810-294-20).

28. Boom Will Not Raise

Step 1. Check to determine if boom is in highest position.
Lower boom.
Step 2. Check boom hoist clutch for slipping.
Adjust boom hoist clutch (TM 5-3810-294-20).

29. Clamshell Operates Erratically

Step 1. Check rear drum brake for lagging.
Adjust rear drum shaft (TM 5-3810-294-20).
Step 2. Check front or rear drum clutches for slipping or grabbing.
Adjust drum clutches (TM 5-3810-294-20).
Step 3. Check bucket hinges for improper lubrication.
Lubricate bucket hinges.

30. Dragline Not Operating Properly

Step 1. Check for improper adjustment of dump cable.
Adjust dump cable (TM 5-3810-294-10).
Step 2. Check for improper adjustment of front or rear drum brakes.
Adjust drum brakes (TM 5-3810-294-10).
Step 3. Check for sticking fairlead rollers or sheaves.
Lubricate rollers and/or sheaves.

31. Shovel Not Operating Properly

Step 1. Check for improper adjustment of front or rear drum brakes.
Adjust drum brakes (TM 5-3810-294-10).
Step 2. Check for improper adjustment of dipper pitch brace.
Adjust dipper pitch brace (TM 5-3810-294-10).

32. Backhoe Not Operating Properly

Step 1. Check for improper adjustment of front or rear drum brakes.
Adjust drum brakes (TM 5-3810-294-10).
Step 2. Check for incorrect dipper pitch.
Adjust dipper pitch (TM 5-3810-294-10).
Step 3. Check for cable out of sheave.
Place cable in sheave.

33. Pile Driver Not Operating Properly

Step 1. Check for improper adjustment of front or rear drum brakes.
Adjust drum brakes (TM 5-3810-294-10).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Check for hammer binding on pile leads.
Lubricate hammer.

34. Hard or Excessive Lever or Pedal Operation

Step 1. Check for lack of lubrication.
Lubricate levers and pedals.
Step 2. Check for improper adjustment.
Adjust levers and pedals (TM 5-3810-294-20).

35. Revolving Frame Will Not Swing

Step 1. Check to determine if swing brake and/or swing lock are engaged.
Disengage swing brake and/or swing lock.
Step 2. Check swing clutch for improper adjustment.
Adjust swing clutch (TM 5-3810-294-10).
Step 3. Check for broken swing shaft.
Replace shaft (Chap 5).

36. Revolving Frame Teethers

Step 1. Check for improper adjustment of hook rollers.
Adjust hook rollers (TM 5-3810-294-20).
Step 2. Check for worn hook roller parts.
Repair hook rollers (Chap 8).

37. Any Side Mounted Shaft Shows Signs of Grease or Oil Leakage

Step 1. Check for faulty oil seals.
Remove faulty components, overhaul and replace the seal or seals.

Page 2-10. Key to fig. 2-1 (1), change item "18" to read "cotter pin"; change item "19" to read "lockwasher (4)"; and change item 28 to read "Door".

Page 2-12. Figure 2-1 (sheet 2 of 6), illustration of item "20", extend line to identify "Bracket".

Page 2-13. Figure 2-1 (sheet 3 of 6), extreme right end of illustration, where items 12 and 13 are shown as nut and lockwasher, change to read "3" for nut and "4" for lockwasher.

Page 2-14. Key to fig. 2-1(4), change items to read as follows: "59, Capscrew (14)", and "61, Bottom Panel".

Page 2-15. Figure 2-1 (sheet 4 of 6), where items 17 and 18 appear in upper portion of illustration, change to show "17" as "cover plate" and "18" as "gasket".

Page 2-20. Paragraphs 2-11 and 2-12, where "Refer to TM 5-3810-294-10" appears, change to read, "Refe to TM 5-3810-294-20".

Page 2-21. Figure 2-3 is superseded.

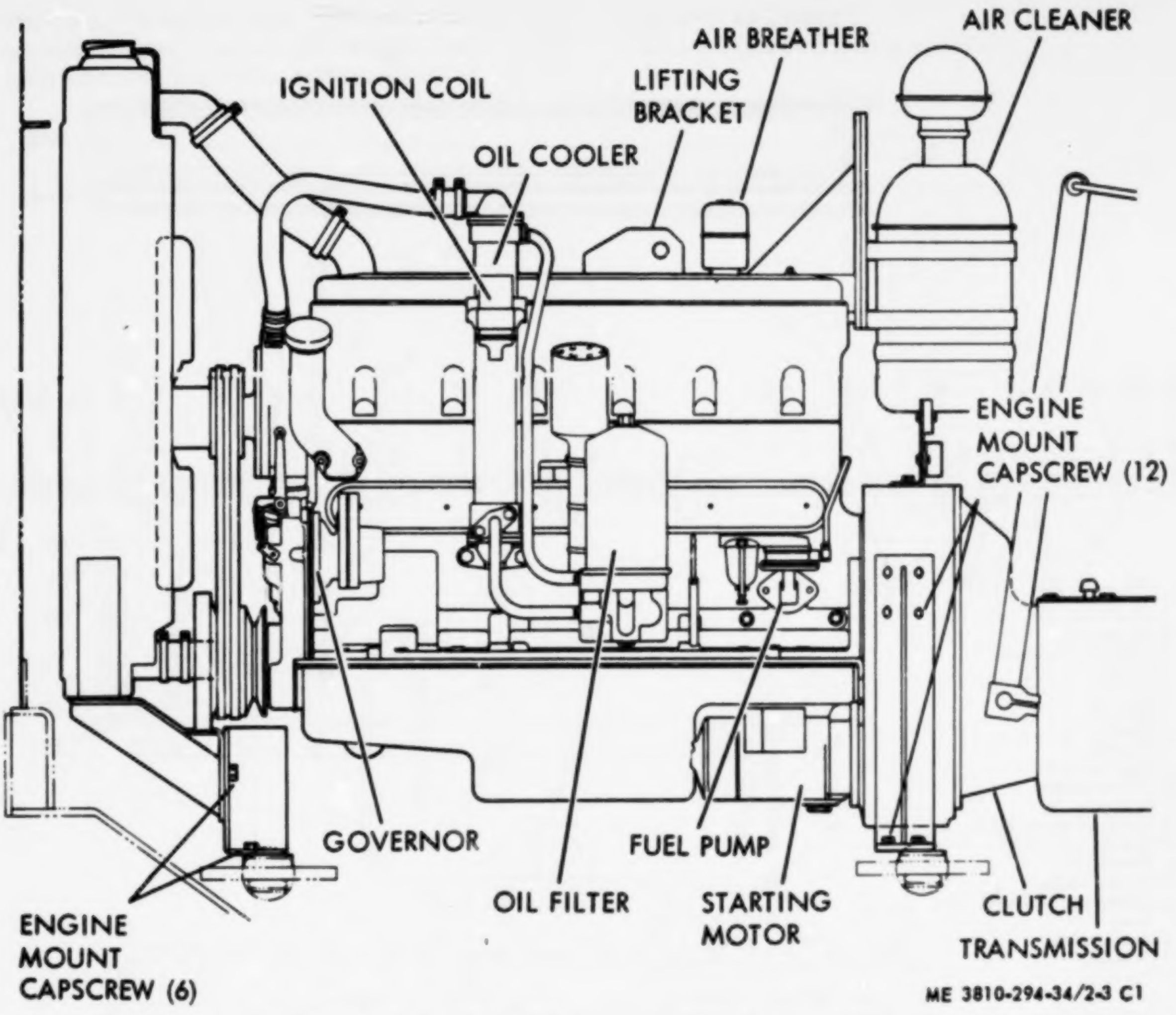

AIR CLEANER
AIR BREATHER
LIFTING BRACKET
IGNITION COIL
OIL COOLER
ENGINE MOUNT CAPSCREW (12)
GOVERNOR
FUEL PUMP
OIL FILTER
STARTING MOTOR
CLUTCH
TRANSMISSION
ENGINE MOUNT CAPSCREW (6)
ME 3810-294-34/2-3 C1

Figure 2-3. Engine and transmission assembly, removal and replacement.

Paragraph 2-13*b*(9), line 4, change "figure 2-4" to read "figure 2-3".

***Page 2-22.* Figure 2-4 is rescinded.**

Paragraph 2-13*c*(1) change second sentence to read "Install mounting capscrews".

***Page 2-30.* Paragraph 2-20*a*(1) (e) is superseded.**

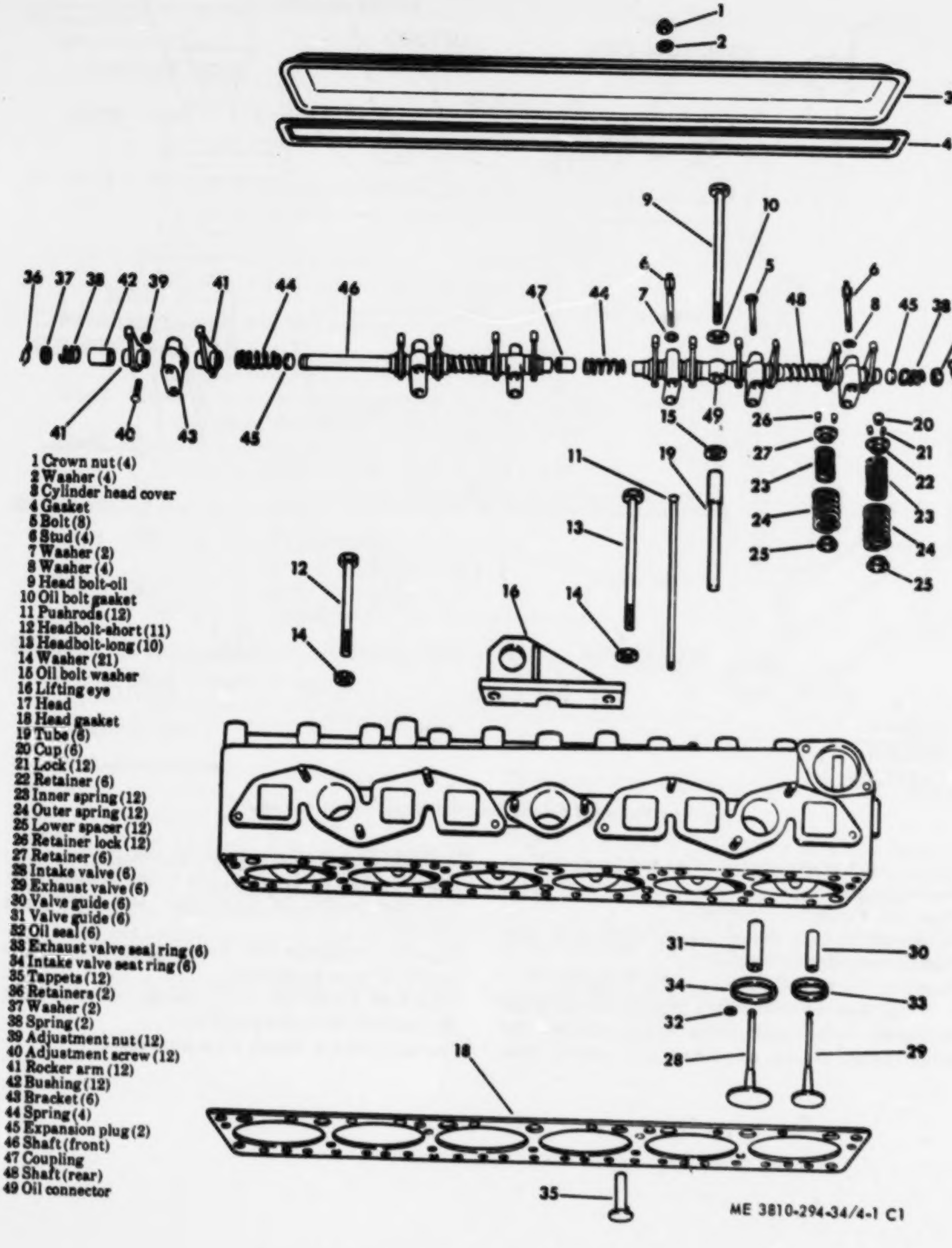
***(e)* Remove cover which provides access to the horizontal swing shaft drive chains. Loosen the drive chains. Disconnect chains and remove from the boom hoist shaft sprockets (33) and (38)."**

***Page 3-4.* Figure 3-2, extend line to field frame shown in center portion of illustration and identify as item "5".**

***Page 3-5.* Paragraph 3-9*a*, line 2, change "lever housing(7)" to "lever housing(9)".**

***Page 3-13.* Paragraph 3-27*g*, change "drive housing (21)" to read "drive housing (24)".**

***Pages 4-1 and 4-2.* Figure 4-1 is superseded.**


1
2
3
4
9
10
36
37
38
42
39
41
44
46
47
44
6
7
5
48
6
8
45
38
37
41
40
43
45
15
49
26
20
27
21
22
23
23
24
24
25
25
36
11
19
13
12
16
14
14
31
30
34
33
32
28
29
18
35

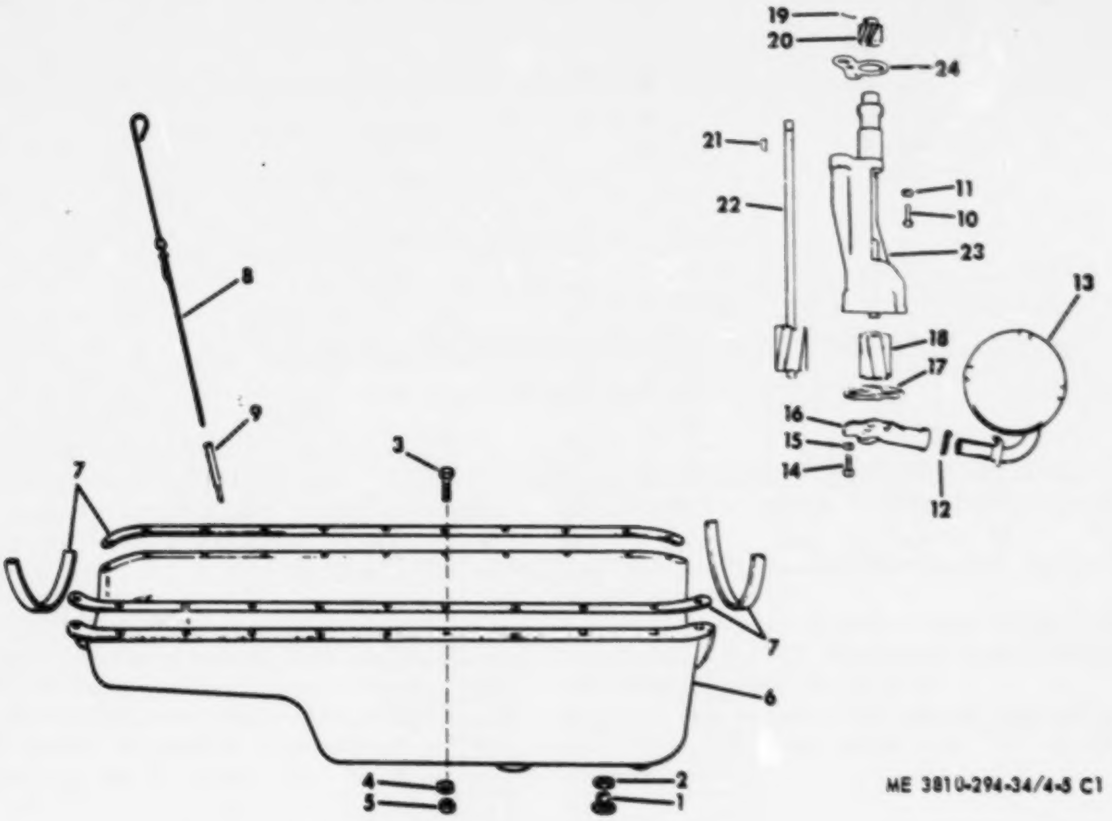
1 Crown nut (4)
2 Washer (4)
3 Cylinder head cover
4 Gasket
5 Bolt (8)
6 Stud (4)
7 Washer (2)
8 Washer (4)
9 Head bolt-oil
10 Oil bolt gasket
11 Pushrods (12)
12 Headbolt-short (11)
13 Headbolt-long (10)
14 Washer (21)
15 Oil bolt washer
16 Lifting eye
17 Head
18 Head gasket
19 Tube (6)
20 Cup (6)
21 Lock (12)
22 Retainer (6)
23 Inner spring (12)
24 Outer spring (12)
25 Lower spacer (12)
26 Retainer lock (12)
27 Retainer (6)
28 Intake valve (6)
29 Exhaust valve (6)
30 Valve guide (6)
31 Valve guide (6)
32 Oil seal (6)
33 Exhaust valve seal ring (6)
34 Intake valve seat ring (6)
35 Tappets (12)
36 Retainers (2)
37 Washer (2)
38 Spring (2)
39 Adjustment nut (12)
40 Adjustment screw (12)
41 Rocker arm (12)
42 Bushing (12)
43 Bracket (6)
44 Spring (4)
45 Expansion plug (2)
46 Shaft (front)
47 Coupling
48 Shaft (rear)
49 Oil connector

ME 3810-294-34/4-1 C1

Figure 4-1. Cylinder head, rocker arm, and valve, exploded view.

Page 4-4. Paragraph 4-12 "Removal", change first sentence to read "Remove the radiator (refer to TM 5-3810-294-20). then refer to figure 4-3 and remove gear cover as follows".

Page 4-8. Figure 4-5 is superseded.

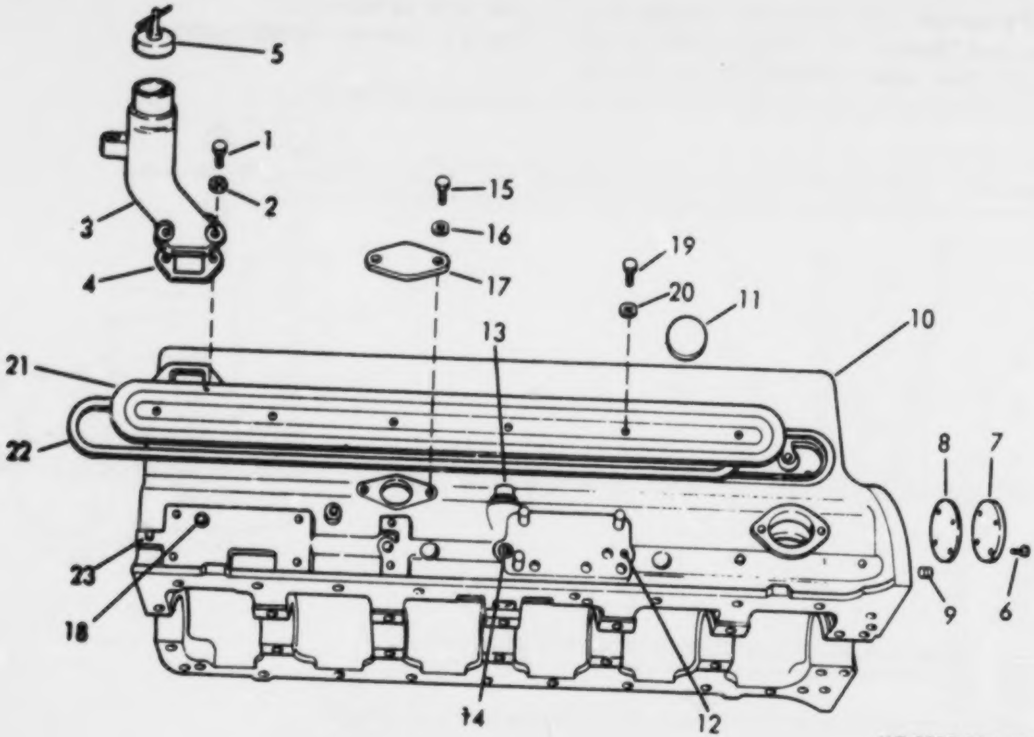


1 Plug
2 Gasket
3 Capscrew (20)
4 Lockwasher (22)
5 Nut (12)
6 Pan
7 Gasket, set
8 Dipstick
9 Tube
10 Capscrew (2)
11 Washer (2)
12 Cotter pin
13 Screen
14 Capscrew (6)
15 Lockwasher (6)
16 Cover
17 Gasket
18 Gear
19 Pin
20 Drive gear
21 Key
22 Shaft
23 Body
24 Gasket

Figure 4-5. Oil pan and oil pump, exploded view.

Page 4-8. Paragraph 4-26*a*, before "Remove plug (1)", add "Remove lower section of exhaust cross-over pipe".

Page 4-13. Figure 4-7 is superseded.



ME 3810-294-34/4-7 C1

1 Capscrew (2)
2 Lockwasher (2)
3 Oil filter
4 Gasket
5 Cap
6 Capscrew (4)
7 Camshaft cover
8 Gasket
9 Plug
10 Crankcase
11 Expansion plug (5)
12 Plug (2)
13 Distributor tube
14 Plug
15 Capscrew (2)
16 Lockwasher (2)
17 Cover
18 Plug
19 Capscrew (6)
20 Washer (6)
21 Valve lifter cover
22 Gasket
23 Plug

Figure 4-7. Crankcase, exploded view

Page 5-21. Figure 9 (sheet 2 of 2), upper left portion of illustration, change item "12" to read "19".

Page 6-3. Key to figure 6-1, change item "41, Capscrew", to read "41, Pin, clevis".

Page 6-4. Paragraph 6-5, line 5, change "(13 and 17)" to read "(17 and 76, fig. 6-1)".

Page 7-4. Paragraph 7-8*a*, add

"Caution:
Cleaning solvent will cause rubber parts to deteriorate".

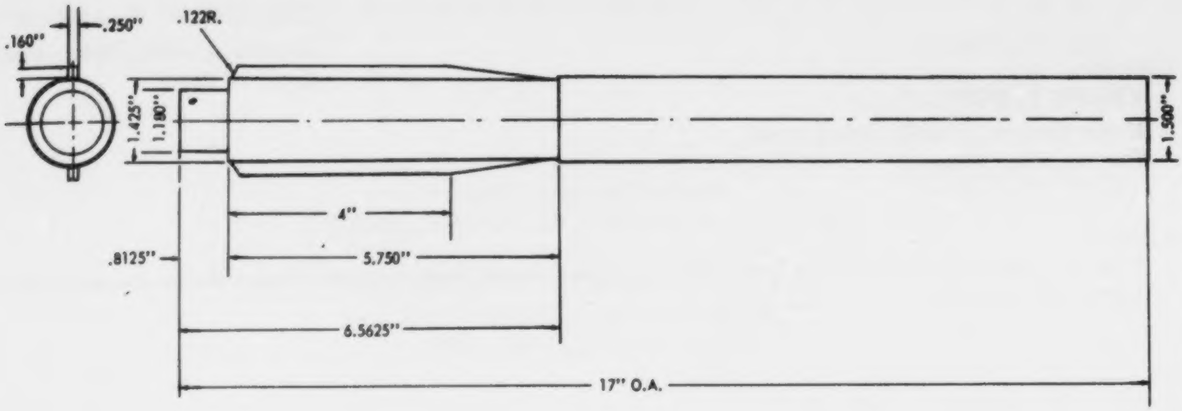
Page 8-3. Paragraph 8-7*b*, is rescinded.

Page 9-1. Paragraph 9-2, add "Refer to paragraph 2-12 for removal and installation of gantry".

Page 11-1. Paragraph 11-2 is superseded.

"11-2. Specially Designed (Fabricated) Tools and Equipment.

One specially designed (fabricated) tool is required to perform Direct Support or General Support maintenance. Refer to figure 11-0 for fabrication."



ME 3810-294-34/11-0 C1

Figure 11-0 (Added). Clutch alinement tool

Page 11-9. Paragraph 11-11*a*(6) is rescinded. Renumber subparagraphs as required.

Page 13-12. Paragraph 13-44*e*, change second sentence to read "Install gasket (5) and valve plug (4)".

Page 14-8. Key to figure 14-5, add item "30A, Companion Flange".

Page 14-9. Figure 14-5, item illustrated between items 30 and 31, extend line and identify as "30A".

Page 14-16. Paragraph 14-17*a*, line 3, change to read "plate (3) over the clutch alignment tool (fig. 11-1)". Delete second sentence of subparagraph *a*. Subparagraph *b*, line 1, change word "shaft" to read "tool".

Subparagraph *d*, change word "shaft" to read "tool".

Subparagraph *f*, change "(Step *q* below)" to read "(para 14-19)".

Page 15-1. Key to fig. 15-1, "19, Bracket", change to read "19, Lockwasher".

Page 18-1. Paragraph 18-2*a*(2), change "(1, fig 16-6)" to read "(1, fig 16-5)". Paragraph 18-2*c*(1) change "(29, fig 16-6)" to read "(29, fig 16-5)".

Page 18-6. Key to figure 18-3, change item "26" to read "cotter pin", and change item "27" to read "yoke pin".

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25B (qty rqr block no. 335) Direct and General Support Maintenance requirements for Cranes, Truck Mounted.

Changes in force: C 1 and C 2

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *7 June 1983*

Direct Support and General Support Maintenance Manual
CRANE, TRUCK MOUNTED, ¾ CU. YDS., 20 TON W/CLAMSHELL, DRAGLINE AND BACKHOE ATTACHMENTS, G.E.D., (HARNISHFEGER MODEL M320T2)
NSN 3810-00-151-4431

TM 5-3810-294-34, 13 May 1971, is changed as follows:

Page 1-1, paragraph 1-4*b*(2). Change "201 net H.P. @ 2800 rpm" to read "201 net H.P. @ 2600 rpm", and "2800 ± 10 rpm" to read "2800 ± 50 rpm".

Page 1-2, paragraph 1-4*b*(3`. Change "0.015 to 0.030 inch" to read "0.028 to 0.033 inch".

Page 2-5, Malfunction 22. Probable cause *c* is superseded as follows:
c. Tires worn, wrong air pressure, out of alinement.

Page 4-12, paragraph 4-37*b,* line 3. Change "comshaft" to read "camshaft".

Page 13-9, paragraph 13-37. Subparagraph *d* is added as follows:
d. Engine block may be re-bored up to "0.020" and oversize pistons used. See TM 5-3810-294-34P.

Page 14-17. Paragraph 14-19*a* is superseded as follows:
a. Adjust release sleeve (28, fig. 14-6) to ¾ inch clearance between contact surface of release housing (25, fig. 14-6) and the face of bearing cap (1, fig. 14-3)."

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:
ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25B, Direct and General Support Maintenance requirements for Cranes: Truck Mounted.

TECHNICAL MANUAL }
No. 5-3810-294-34 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *13 May 1971*

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

CRANE, TRUCK MOUNTED, ¾ CU. YDS., 20 TON W/CLAMSHELL, DRAGLINE AND BACKHOE ATTACHMENTS, G.E.D

(HARNISHFEGER MODEL M320T2)

FSN 3810-151-4431

PART ONE. CRANE (REVOLVING FRAME)

			Paragraph	Page
CHAPTER	1.	INTRODUCTION		
Section	I.	General	1-1	1-1
	II.	Description and data	1-3	1-1
CHAPTER	2.	DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS		
Section	I.	Repair parts, special tools and equipment	2-1	2-1
	II.	Troubleshooting	2-3	2-1
	III.	General maintenance	2-5	2-7
	IV.	Removal and installation of major Components and auxiliaries	2-10	2-10
CHAPTER	3.	REPAIR OF CRANE ENGINE ACCESSORIES		
Section	I.	Repair of alternator	3-1	3-1
	II.	Repair of starting motor	3-7	3-3
	III.	Repair of distributor	3-13	3-6
	IV.	Repair of carburetor	3-19	3-8
	V.	Repair of governor	3-25	3-12
	VI.	Repair of water pump	3-31	3-14
	VII.	Repair of radiator	3-37	3-15
CHAPTER	4.	REPAIR OF CRANE ENGINE		
Section	I.	General	4-1	4-1
	II.	Repair of cylinder head, rocker arm and valves	4-4	4-1
	III.	Repair of gear cover	4-11	4-4
	IV.	Repair of flywheel and housing	4-18	4-6
	V.	Repair of oil pan and oil pump	4-25	4-7
	VI.	Repair of camshaft, crankshaft, pistons and rods	4-32	4-9
	VII.	Repair of engine crankcase	4-39	4-12
CHAPTER	5.	REPAIR OF CRANE DRIVE TRAIN		
Section	I.	Repair of crane transmission and clutch	5-1	5-1
	II.	Repair of crane propeller shaft	5-9	5-10
	III.	Repair of crane worm shaft	5-15	5-11
	IV.	Repair of boom hoist shaft	5-21	5-13
	V.	Repair of rear drumshaft	5-25	5-14
	VI.	Repair of front drumshaft	5-31	5-19
	VII.	Repair of reversing shaft	5-37	5-22
	VIII.	Repair of horizontal swing shaft	5-43	5-25
	IX.	Repair of swing brake shaft	5-49	5-27
	X.	Repair of vertical swing shaft	5-51	5-27

CHAPTER 6. REPAIR OF CRANE LOCKS, BRAKES AND PAWLS — Paragraph Page

Section I. Repair of hand operated pawls and swing lock assembly 6-1 6-1
II. Repair of automatic planetary boom hoist pawls 6-4 6-3
III. Repair of swing lock 6-6 6-4

CHAPTER 7. REPAIR OF CRANE CAB COMPONENTS AND CONTROLS

Section I. Repair of swing brake control stand 7-1 7-1
II. Repair of master cylinder 7-5 7-3
III. Repair of engine control panel 7-10 7-5
IV. Repair of operator's seat 7-13 7-5

CHAPTER 8. REPAIR OF REVOLVING FRAME AND WIRING HARNESS

Section I. Repair of hook roller 8-1 8-1
II. Repair of battery cables, suppression Leads, and wiring harness 8-7 8-3

CHAPTER 9. REPAIR OF CRANE GANTRY AND BOOM COMPONENTS

Section I. Repair of gantry 9-1 9-1
II. Repair of hook block 9-3 9-3
III. Repair of sheaves and boom rollers 9-9 9-5
IV. Repair of crane, dragline, and clamshell boom 9-12 9-5
V. Repair of shovel and backhoe attachment 9-14 9-6
VI. Repair of fairlead assembly 9-17 9-6

PART TWO. CARRIER

CHAPTER 10. INTRODUCTION

Section I. General 10-1 10-1
II. Description and data 10-3 10-1

CHAPTER 11. DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. Repair parts, special tools and equipment 11-1 11-1
II. Troubleshooting 11-3 11-1
III. General maintenance 11-5 11-1
IV. Removal and installation of major components and auxiliaries 11-6 11-1

CHAPTER 12. REPAIR OF CARRIER ENGINE ACCESSORIES

Section I. Repair of alternator 12-1 12-1
II. Repair of starting motor 12-2 12-1
III. Repair of distributor 12-3 12-1
IV. Repair of carburetor 12-9 12-4
V. Repair of water pump 12-15 12-8
VI. Repair of air compressor 12-21 12-10
VII. Repair of hydraulic pump 12-27 12-13
VIII. Repair of radiator 12-33 12-14

CHAPTER 13. REPAIR OF CARRIER ENGINE

Section I. General 13-1 13-1
II. Repair of cylinder head, rocker arm and valves 13-4 13-1
III. Repair of gear cover 13-11 13-4
IV. Repair of flywheel 13-18 13-6
V. Repair of oil pan and oil pump 13-25 13-7
VI. Repair of crankshaft, camshaft and piston rings 13-32 13-8
VII. Repair of crankcase 13-39 13-10

CHAPTER 14. REPAIR OF CLUTCH CONTROL, TRANSMISSION, AND CLUTCH ASSEMBLIES

Section I. Repair of clutch control 14-1 14-1
II. Repair of transmission assembly 14-6 14-3
III. Repair of clutch assembly 14-12 14-14

CHAPTER 15. REPAIR OF POWER TRANSFER COMPONENTS

Section I. Repair of propeller shafts 15-1 15-1
II. Repair of transfer case 15-7 15-3

CHAPTER 16. REPAIR OF STEERING GEAR, FRONT AXLE DIFFERENTIAL ASSEMBLY, AND FRONT AXLE ASSEMBLY

Section I. Repair of steering gear 16-1 16-1
II. Repair of front axle differential assembly 16-7 16-7
III. Repair of front axle assembly 16-14 16-10

			Paragraph	Page
CHAPTER	17.	REPAIR OF REAR DRIVE AND SUSPENSION ASSEMBLIES		
Section	I.	Repair of rear suspension assembly	17-1	17-1
	II.	Repair of hub and drum, interaxle differential, and rear axle assemblies	17-4	17-3
CHAPTER	18.	REPAIR OF CARRIER BRAKES		
Section	I.	Repair of front brakes	18-1	18-1
	II.	Repair of rear brakes	18-4	18-3
CHAPTER	19.	REPAIR OF WIRING HARNESSES AND CARRIER FRAME		
Section	I.	Repair of wiring harnesses	19-1	19-1
	II.	Repair of carrier frame	19-4	19-1

LIST OF ILLUSTRATIONS

Number	Title	Page
1-1	Upper Hydraulic System, Schematic Diagram	1-3
2-1	Cab Sheet Metal, Removal and Replacement	2-11
2-2	Gantry Assembly, Removal and Installation	2-20
2-3	Engine and Transmission Assembly, Removal and Replacement	2-21
2-4	Engine Mount Capscrews, Removal and Replacement	2-22
2-5	Transmission / Clutch Assembly, Removal and Replacement	2-23
2-6	Rear Drumshaft Assembly, Removal and Installation	2-23
2-7	Front Drumshaft Assembly, Removal and Installation	2-25
2-8	Reversing Shaft Assembly, Removal and Installation	2-26
2-9	Horizontal Swing Shafts (Left and Right), Removal and Installation	2-28
2-10	Worm Shaft Assembly, Removal and Installation	2-29
2-11	Boom Hoist Shaft Assembly, Removal and Replacement	2-30
2-12	Vertical Swing Shaft, Removal and Installation	2-32
2-13	Checking Vertical Swing Shaft Bevel Gear Backlash	2-33
2-14	Checking Gear Tooth Contact	2-34
2-15	Swing Brake Shaft, Removal, Disassembly, and Replacement	2-36
2-16	Control Stand Assembly, Removal and Installation	2-37
3-1	Alternator Assembly, Exploded View	3-1
3-2	Starting Motor, Exploded View	3-4
3-3	Distributor, Exploded View	3-7
3-4	Carburetor, Exploded View	3-9
3-5	Governor, Exploded View	3-13
3-6	Water Pump, Exploded View	3-14
4-1	Cylinder head, Rocker Arm, and Valve, Exploded View	4-2
4-2	Crane Engine Head Bolt Tightening	4-4
4-3	Gear Cover, Exploded View	4-5
4-4	Flywheel and Housing, Exploded View	4-6
4-5	Oil Pan and Oil Pump, Exploded View	4-8
4-6	Camshaft, Crankshaft, Piston and Rod, Exploded View	4-10
4-7	Crankcase, Exploded View	4-13
5-1	Inter-relationship of Crane Drive Train Major Components	5-2
5-2	Engine Clutch Assembly Exploded View	5-4
5-3	Transmission Assembly Exploded View	5-7
5-4	Transmission / Clutch Assembled View	5-8
5-5	Propeller Shaft Assembly Exploded View	5-10
5-6	Worm Shaft Assembly Exploded View	5-12
5-7	Rear Drumshaft Assembly Exploded View	5-15
5-8	Front and Rear Drum Clutch Assembly Exploded View	5-17
5-9	Front Drumshaft Assembly Exploded View	5-20
5-10	Reversing Shaft Assembly Exploded View	5-23
5-11	Reversing Shaft Clutch Assembly Exploded View	5-24
5-12	Horizontal Swing Shaft Assembly Exploded View	5-26
6-1	Hand Operated Pawls and Swing Lock Assembly Exploded View	6-2
6-2	Automatic Planetary Boom Hoist Pawls Assembly	6-4
6-3	Swing Lock Assembly Exploded View	6-5
7-1	Swing Brake Control Stand Assembly Exploded View	7-2
7-2	Master Cylinder Assembly Exploded View	7-4
7-3	Operator's Seat Assembly Exploded View	7-6
8-1	Hook Roller Assembly Exploded View	8-2
9-1	Gantry Assembly Exploded View	9-2
9-2	Hook Block Exploded View	9-4
9-3	Fairlead Assembly Exploded View	9-7
11-1	Carrier Cab Assembly Exploded View	11-2
11-2	Engine Removal and Installation	11-4
11-3	Transmission Assembly, Removal and Installation	11-6
11-4	Transfer Case, Removal and Installation	11-8
11-5	Front Axle and Spring Assembly; Removal and Installation	11-9
11-6	Rear Axles, Removal and Installation	11-10
12-1	Distributor Exploded View	12-2
12-2	Governor Adjusting Tool	12-3
12-3	Carburetor, Exploded View	12-6
12-4	Water Pump, Exploded View	12-9
12-5	Air Compressor Assembly, Wxploded View	12-11
12-6	Hydraulic Pump, Exploded View	12-13
13-1	Cylinder Head, Rocker Arm, and Valve, Exploded View	13-2
13-2	Carrier Engine Head Bolt Tightening Sequence	13-4
13-3	Gear Cover, Exploded View	13-5

Number	Title	Page
13-4	Flywheel, Exploded View	13-6
13-5	Oil Pan and Oil Pump Exploded View	13-7
13-6	Camshaft, Pistons, and Crankshaft, Exploded View	13-8
13-7	Crankcase, Exploded View	13-11
14-1	Clutch Control, Exploded View	14-2
14-2	Remote Control Assembly, Exploded View	14-3
14-3	Carrier Transmission Exploded View	14-5
14-4	Manual Control Assembly, Exploded View	14-7
14-5	Drop Gear Unit, Exploded View	14-9
14-6	Clutch Assembly, Exploded View	14-15
14-7	Location of Hold Down Bolts	14-16
14-8	Release Lever Height Adjustment	14-17
15-1	Propeller Shafts; Exploded View	15-2
15-2	Transfer Case, Exploded View	15-4
16-1	Steering Assembly, Exploded View	16-2
16-2	Steering Column, Exploded View	16-3
16-3	Steering Gear Assembly, Exploded View	16-4
16-4	Differential Assembly, Exploded View	16-8
16-5	Front Axle Assembly, Exploded View	16-11
17-1	Rear Suspension Assembly, Exploded View	17-2
17-2	Hub and Drum Assembly	17-4
17-3	Rear Axle Assembly, Exploded View	17-6
17-4	Interaxle Differential, Exploded View	17-8
17-5	Measuring Cross Shaft Preload Torque	17-10
17-6	Measuring Pinion Bearing Preload Torque (Forward-Rear Axle)	17-10
17-7	Measuring Pinion Bearing Preload Torque (Rear-Rear Axle)	17-12
18-1	Front Brake Chamber, Exploded View	18-2
18-2	Rear Brake Assembly, Exploded View	18-4
18-3	Rear Brake Chamber, Exploded View	18-6

PART ONE

CRANE (REVOLVING FRAME)

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for the use of Direct Support and General Support personnel maintaining the model M320T2 truck crane. It gives instructions for maintenance, as specified in the Maintenance Allocation Chart (MAC), which is beyond the scope of Operator / Crew or Organizational Maintenance personnel.

b. This manual is divided into two parts. Part One covers repair instructions for the crane (revolving frame) portion of the truck crane. Part Two covers repair of the carrier portion of the truck crane. Maintenance personnel should read the instructions contained in this manual before repairing the equipment.

c. Refer to appendix A for a list of publications applicable to this manual.

d. Numbers in parentheses on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

1-2. Forms and Records

a. Maintenance records and reports which are used by maintenance personnel at all levels are listed in and prescribed by TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, (Recommended Changes to Publications) and forwarded direct to Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Blvd., St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-3. Description

a. A general description of the model M320T2 truck crane and information pertaining to the identification plates are contained in TM 5-3810-294-10 and TM 5-3810-294-20. Equipment operating instructions are also contained in TM 5-3810-294-10.

b. A detailed description of specific components and assemblies is contained, as applicable, in the maintenance sections of this manual.

1-4. Tabulated Data

a. General. This section supplements the tabulated data contained in TM 5-3810-294-10 and TM 5-3810-294-20. (Refer to these technical manuals as required.)

b. Tabulated data.

(1) *Truck crane.*

Manufacturer	Harnischfeger Corporation
Model	M320T2

(2) *Carrier engine.*

Manufacturer	International Harvester Company
Model	UV-549
Number of cylinders	8
Horsepower	201 net hp at 2800 rpm full load
Displacement	549 cubic inches
Ignition timing	Top dead center
Governed speed (high idle)	2800±10 rpm
Low idle speed	450±50 rpm
Maximum oil pressure (above 1500 rpm)	50 to 55 pounds per square inch
Minimum oil pressure (idling)	15 to 20 pounds per square inch
Intake and exhaust valve tappet clearance	Engine equipped with hydraulic valve lifters. Tappet clearance adjustments not required.
Electrical system	24 volts, negative ground
Spark plug gap	0.028 to 0.033 inch
Distributor point gap	0.017 inch

(3) *Crane engine.*

Manufacturer	International Harvester Company

Model	U-450
Ignition timing	Top dead center
Number of cylinders	6
Horsepower	92.5 net hp at 1800 rpm full load
Intake valve tappet clearance (hot)	0.024 to 0.026 inch
Exhaust valve tappet clearance (hot)	0.024 to 0.026 inch
Displacement	450.9 cubic inches
Governed speed	2025±25
Low idle speed	475 to 525 rpm
Maximum oil pressure at governed speed	35 to 45 psi (approx.)
Minimum oil pressure at low idle	8 to 15 psi
Electrical system	24 volts, negative ground
Spark plug gap	0.015 to 0.030 inch
Distributor point gap	0.022 inch

(4) *Dimensions and transportation data.*

Overall length, with boom in travel position	536 inches
Overall length, without boom	326.25 inches
Overall width	119 inches
Overall height, at gantry sheave shaft	149.25 inches
Shipping cubage	3,354 cubic feet
Shipping tonnage	85 tons

(5) *Approximate weights.*

Truck crane with counterweight and boom	59,860 pounds
Truck crane with counterweight and without boom	55,380 pounds
Carrier	29,640 pounds
Crane upper with counterweight	25,740 pounds
Crane upper without counter weight	20,360 pounds
Boom tip section with two guy lines attached	1,460 pounds
Boom insert, 10 foot	500 pounds
Guy lines, 10 foot, set of two	100 pounds
Boom base section	1,020 pounds
Upper spreader	220 pounds
Hook block	480 pounds
Boom backstops with pins	1,000 pounds
Fairlead	732 pounds

(6) *Speeds (full throttle and full load.)*

Rear drum shaft	48.4 rpm
Rear drum shaft lowering	Gravity
Front drum shaft raising	48.4 rpm
Front drum shaft lowering	26.175 rpm
Front drum line speed, lowering	92.4 feet per minute
Boom hoist drum shaft	96.8 rpm
Boom hoist drum shaft, lowering	45.8 rpm
Boom hoist drum line speed, lowering	112.5 feet per minute
Revolving frame rotation	4.06 rpm

(7) *Rated capacities.*

Crane	20 tons (See rating plate)
Clamshell	¾ cubic yard
Dragline	¾ cubic yard
Backhoe	¾ cubic yard
Shovel	¾ cubic yard
Rear drum line pull, sea level	15,900 pounds
Rear drum line pull, 5000 feet altitude	12,550 pounds
Front drum line pull, sea level	15,400 pounds
Front drum line pull, 5000 feet altitude	12,200 pounds
Boom hoist drum line pull	7,000 pounds

(8) *Fuel, water, oil, and grease capacities, Carrier.*

Engine fuel tank	75 gallons
Cooling system	40 quarts
Crankcase	12 quarts including filter
Transmission	8 quarts
Drop box	4 quarts
Transfer case	8½ pints
Front axle	11 quarts
Forward rear axle	11½ quarts
Rear axle	11 quarts
Steering gear and tank	7 pints

(9) *Fuel, water, and oil capacities, Crane*

Engine fuel tank	50 gallons
Cooling system	35 quarts
Crankcase	9 quarts including filter
Transmission	9 pints
Gear and chain case	18 gallons
Hydraulic system reservoir	3 quarts

(10) *Working ranges.* Refer to TM 5-3810-294-10 for the working ranges of the front end attachments furnished with the model M320T2 truck crane.

(11) *Wiring diagram.* Refer to TM 5-3810-294-20 for the truck crane wiring diagram.

(12) *Hydraulic schematic.* Refer to figure 1-1 for the schematic of the upper hydraulic system.

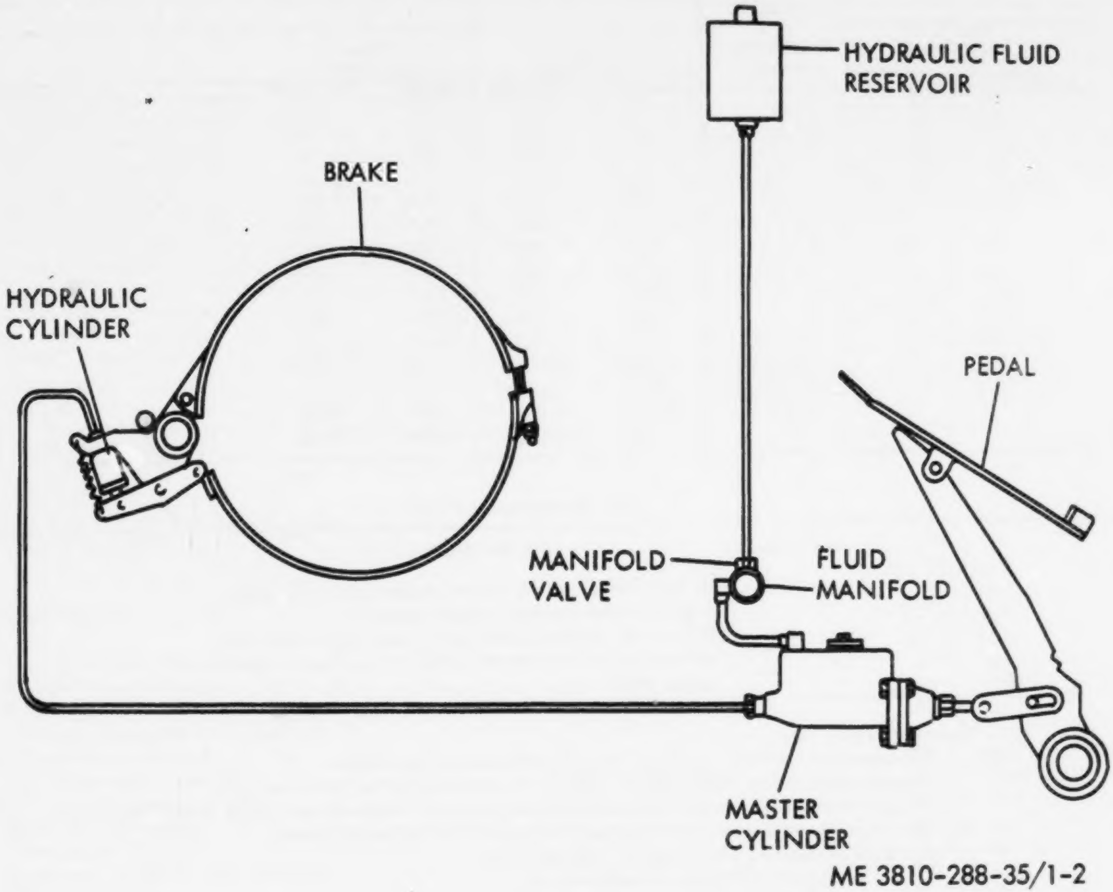

HYDRAULIC FLUID RESERVOIR
BRAKE
HYDRAULIC CYLINDER
PEDAL
MANIFOLD VALVE
FLUID MANIFOLD
MASTER CYLINDER
ME 3810-288-35/1-2

Figure 1-1. Upper hydraulic system, schematic diagram.

(13) *Torque values.* General torque values are listed in tables 1-1 and 1-2. When specific torque values are given, refer to table 1-3.

(14) *Repair and replacement standards.* Refer to table 1-4 for the model M320T2 truck crane repair and replacement standards.

Table 1-1. General torque values (except engines)

SAE Grade No.	1 or 2		5	
Bolt body size (Inches) — (thread)	Torque Foot-Pounds		Torque Foot-Pounds	
	Minimum	Maximum	Minimum	Maximum
1/4-20	4	6	7	9
1/4-28	5	7	9	11
5/16-18	10	12	16	18
5/16-24	12	14	18	20
3/8-16	17	19	30	32
3/8-24	19	21	34	36
7/16-14	27	29	48	50
7/16-20	29	31	54	56
1/2-13	38	40	73	77
1/2-20	40	42	83	87
9/16-12	50	52	105	115
9/16-18	54	56	115	125
5/8-11	81	85	145	155
5/8-18	93	97	165	175
3/4-10	110	110	265	275
3/4-16	110	120	290	300
7/8-9	155	165	390	400
7/8-14	170	180	425	440
1-8	230	240	580	600
1-14	240	250	650	670

Table 1-2. General torque values for engines

SAE Grade No.	5		8	
Bolt body size (Inches)	Torque Foot-Pounds		Torque Foot-Pounds	
	Minimum	Maximum	Minimum	Maximum
1/4	9	10	12	14
5/16	19	21	27	30
3/8	33	37	45	50
7/16	53	60	75	85
1/2	80	90	115	130
9/16	115	130	160	180
5/8	160	180	220	250
3/4	290	320	400	450
7/8	420	470	650	730
1	630	710	970	1090
1-1/8	850	950	1380	1550
1-1/4	1200	1350	1940	2180
1-1/2	2000	2300	3300	3700
1-3/4	3300	3700	5300	6000
2	5000	5500	8000	9000

Bolt Identification Guide

SAE Grade No.	Bolt Head Marking
5	Will have three equally spaced radial lines. Quenched and tempered medium carbon steel.
8	Will have six equally spaced radial lines. Quenched and tempered medium carbon alloy or medium carbon baron steel.

Notes for table 1-2

1. When reusing bolts and nuts in service, use minimum torque values.
2. Torque values are for rigid joints. No gaskets or compressible materials are used.
3. Torque values are for threads lubricated with engine oil or chassis grease. When other lubricants or materials are used, multiply standard assembly torques by the following factors:
   - a. 0.85 when metallic plated bolts or nuts are used.
   - b. 0.75 when parkerized bolts or nuts are used.
   - c. 0.70 when Molykote, white lead or similar mixtures are used as lubricants.
   - d. 0.90 when hardened surfaces are used under the nut or bolt head.
   - e. 1.20 when Loctite is used on the threads of standard bolts and nuts.
   - f. 1.25 when taper head bolts are used (with bolt head torqued).
   - g. 1.40 when Loctite is used on taper head bolt threads (with bolt head torqued.).

Table 1-3. Specific torque values

Component	Torque Value Foot-Pounds	
	Minimum	Maximum
CRANE ENGINE:		
Distributor bracket to cylinder head	18 —	22
Crankshaft rear oil seal, upper	18 —	22
Crankshaft rear oil seal, lower	18 —	22
Carburetor to manifold	20 —	24
Starting motor mounting	25 —	30
Oil pump body to crankcase	25 —	30
Camshaft thrust washer	25 —	30
Damper to pulley hub	25 —	30
Fuel pump to crankcase	30 —	35
Rocker arm bracket to head	25 —	30
Gear case to crankcase	25 —	30
Water pump to cylinder head	25 —	30
Oil pan to crankcase	25 —	30
Oil filler	25 —	30
Gear case cover to crankcase plate	25 —	30
Gear case cover	23 —	28
Manifold to cylinder head	25 —	30

Table 1-3. Specific torque values (Continued)

Component	Torque value Foot-Pounds	
	Minimum	Maximum
Intake to exhaust manifold	55	65
Connecting rod bolt (place type)	75	85
Carburetor to manifold	40	45
Oil filter hold-down bolt	30	35
Oil filter mounting	40	50
Cylinder head bolt, oil	60	70
Cylinder head bolt, long	100	110
Cylinder head bolt, short	100	110
Flywheel housing to crankcase	75	85
Crankshaft to flywheel	150	160
Crankshaft bearing cap	100	110
Camshaft gear nut	110	120
Spark plug	28	30
Note. Torque values are for bolt threads free of dirt and grit and lightly lubricated with engine oil.		
CARRIER ENGINE:		
Crankshaft main bearing cap bolts	100	110
Connecting rod bolts	60	70 (w / hardened washer)
Camshaft nut	125	150
	125	150
Camshaft thrust flange	30	40
Cylinder head bolts	80	90
Rocker arm bracket-to-cylinder head	80	90
Flywheel housing-to-crankcase	65	75
Flywheel-to-crankshaft	90	100
Oil filter-to-crankcase	35	40
Oil filter shell retainer screw	30	35
Carburetor-to-manifold	20	24
Idler pulley adjuster	30	35
Alternator bracket-to-cylinder head	50	60
Alternator-to-bracket	35	40
Spark plugs	28	30
Note. Torque values are for bolt threads free of dirt and grit and lightly lubricated with engine oil.		
TRANSFER CASE:		
Housing and cover	38	42
Main shaft rear bearing cap	60	66
Drive shaft rear bearing cap	60	66
Declutch housing to transfer case housing	60	66
Declutch bearing cage	38	42
Main shaft flange nut	300	400
Front axle drive shaft yoke nut	300	400
Axle drive shaft yoke nut	300	400
Shift cover plate	38	42
Idler shaft front and rear bearing caps	60	66
Main shaft front bearing cap	60	66
Idler shaft bearing retainer	60	66
REAR AXLE ASSEMBLIES:		
Cross shaft bearing cage	116	129
Cross shaft bearing cover	116	129
Differential carrier top, rear, and side covers	26	29
Interaxle differential case	92	102
Pinion bearing adjusting nut	1000	1200
Pinion bearing lock nut	1000	1200
Interaxle differential housing	160	180
Interaxle differential cover	30	33
Input and output yokes	800	1100
Air shift housing	54	58
Interaxle output bearing cover	52	58
Axle differential case assemblies	92	102

Table 1-3. Specific torque values (Continued)

Component	Torque Value Foot-Pounds Minimum	Torque Value Foot-Pounds Maximum
Carrier bearing caps	160	180
Carrier to axle housing	320	360
Gear set (pinion and through shaft) bearing cage	82	91
OTHER:		
Reversing shaft drum capscrews	20	25
Horizontal swing shaft drum capscrews	20	25
Steering wheel nut	55	65
Carrier clutch mounting capscrews	35	40
Release lever adjustment lock nut	60	60

Table 1-4. Repair and Replacement Standards

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
CRANE ENGINE			
General:			
Bore — inches	4⅜		
Stroke — inches	5		
Displacement (cubic inches)	450.990		
Compression ratio	6.5:1		
Compression pressure (at 200 rpm) psi.	141		
Firing order 1-5-3-6-2-4			
CRANKSHAFT:			
Main journal diameter	3.2494	3.2496	
Number of main bearings	7		
Crankpin diameter	2.751	2.752	
Bearing clearance	0.0013	0.0043	
Crankshaft end play	.006	0.015	
Thrust taken by Rear			
Hardening method Tocco			
Bearing OD and spread	3.424	3.449	
CAMSHAFT:			
Camshaft journal diameter:			
Front	2.109	2.110	
Second	2.089	2.090	
Third	2.069	2.070	
Fourth	1.4995	1.5005	
Camshaft bearing clearance	0.0010	0.0035	
Cam lobe lift	0.271	0.271	
Camshaft end play	0.0015	0.0095	
Thrust taken by Thrust flange			
Timing gear blacklash	0.004	0.007	
CONNECTING RODS:			
Connecting rod bearing end clearance	.007	0.013	
Connecting rod bearing clearance	.0012	0.0037	
Bearing OD and spread	2.8985	2.9135	
CYLINDER SLEEVES:			
Inside diameter	4.3740	4.3755	
Max. permissable taper in sleeve			0.005
Max. permissable out-of-round			0.002
Outside diameter	4.5015	4.5020	
Sleeve bore in crankcase	4.5015	4.5020	
Height above crankcase	0.000		+0.006
Length			8 11/16 ± 1/64
Flange thickness			1/32
PISTONS:			
Material Aluminum Alloy			
Recommended piston clearance:			
Top of skirt	0.004	0.0041	
Bottom of skirt	0.003	0.0031	

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
PISTON PINS:			
Length	3.795	3.797	
Diameter	1.1089	1.1090	
Pin fit (room temperature 70°F.)			
Recommended clearance in rod	0.0005	0.0007	
Recommended clearance in piston:			
Tight end	0.0001L	0.0002T	
Loose end	0.0001L	0.0005L	
FEELER GAUGE RIBBON CHECKING:			
Width — inch	½	½	
Thickness — inch	0.003	0.003	
Tension on scales (pounds)	6	18	
Desired tension (pounds)	11	13	
PISTON RINGS:			
Compression rings			
Number used on each piston	2		
Size	3 / 32	3 / 32	
Oil rings:			
Number used on each piston	1		
Size	3 / 16		
Ring diameter	4⅜	4⅜	
Ring gap:			
Compression	0.025	0.035	
U-Flex-No gap at ring joint (Gap built between ring segments).			
Fit in groove:			
Top	0.0040	0.0055	
Second	0.0020	0.0035	
Third	0.0015	0.0035	
INTAKE VALVES:			
Stem diameter	0.435	0.435	
Valve to rocker arm clearance (hot)	0.024	0.026	
Stem clearance in guide	0.0015	0.0040	
Width of valve seat	5 / 64	7 / 64	
Note. Valve face angle is 45 degrees.			
EXHAUST VALVES:			
Stem diameter	0.4365	0.4375	
Valve to rocker arm clearance (hot)	0.024	0.026	
Stem clearance in guide	0.0020	0.0045	
Width of valve seat	⅛		3 / 32
Slo-roto valve cap to stem clearance	0.001	0.005	
Note. Valve face angle is 45 degrees.			
VALVE GUIDES:			
Distance above head	1-1 / 16		
Inside diameter	0.438	0.499	
VALVE LIFTERS:			
Clearance in block	0.0010	0.0035	
VALVES SPRINGS:			
Free length:			
Inner (new)	2 11 / 32		2 9 / 32
Outer (new)	2 9 / 16		2½
Length — valve open:			
Inner (new)	1½		1¼
Outer (new)	1 45 / 64		1⅝
Pounds pressure-valve open:			
Inner	83	88	
Outer	133	141	

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
VALVE ROCKER ARM CLEARANCE ON SHAFT	0.0015	0.0040	
VALVE TIMING:			
Intake opens (before TDC) degrees	16		
Intake closes (after BDC) degrees	44		
Exhaust opens (before BDC) degrees	50		
Exhaust closes (after TDC) degrees	20		
Intake valve timing checking clearance	0.023		
OIL PUMP:			
Body gear end clearance	0.0025	0.0055	
Pump body to gear clearance	0.0023	0.0025	
Pump shaft diameter	0.4980	0.4979	
Pump shaft clearance in bore (Max.)			0.0018
Body gear backlash	0.003	0.006	
Idler gear to shaft clearance	0.0015	0.0035	
Drive gear backlash	0.005	0.014	
Note. Oil pressure is from 8 to 45 psi (engine at low idle and maximum governed speed, respectively).			
FLYWHEEL HOUSING:			
Permissible run-out	0.000	0.010	
CARRIER ENGINE			
General:			
Bore	4½		
Stroke	4 5/16		
Displacement — cubic inches	549		
Compression ratio	7.57:1		
Gage Compression — 145 psi at 200 rpm			
Firing order 1-8-7-3-6-5-4-2			
CRANKSHAFT:			
Main journal diameter	3.123	3.124	
Crankpin diameter	2.623	2.624	
Bearing clearance	0.0014	0.0044	
Crankshaft end play	0.004	0.009	
Thrust taken by ...... Intermediate			
Hardening method ...... Tocco			
Main bearing bore in crankcase (line reamed with caps in place)	3.316	3.317	
CAMSHAFT:			
Camshaft journal diameter			
Front	2.347	2.348	
Second	2.316	2.317	
Third	2.290	2.291	
Fourth	2.247	2.248	
Camshaft bearing clearance	0.001	0.003	
Camshaft end play	0.0035	0.0115	
Thrust taken by ...... Thrust flange.			
Timing gear backlash	0.001	0.008	
CYLINDER HEAD:			
Over-all height, inches	4.372	4.378	4.362
CONNECTING RODS:			
Connecting rod bearing end clearance	0.010	0.018	
Connecting rod bearing clearance	0.0017	0.0042	
PISTONS:			
Material			
Recommended piston clearance ...... Aluminum Alloy	0.0035	0.0035	
Piston clearance check with ½ inch feeler gage ribbon			
Ribbon thickness	0.0035	0.0035	
Clearance pull — pounds	10	12	14
PISTON PINS:			
Length	3.262	3.265	
Diameter	1.3118	1.3119	
Pin fit (room temperature 70°F.)			

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
PISTON PINS (Continued):			
Clearance in rod	0.0008	0.0011	
Clearance in piston	0.0001T	0.0002T	
PISTON RINGS:			
Compression rings:			
Number used on each piston	3		
Size — inch	3 / 32	3 / 32	
Oil rings:			
Number used on each piston	1		
Size — inch	3 / 16	3 / 16	
Ring gap:			
Compression	0.013	0.025	
U-Flex-No gap at ring joint (Gap built between ring segments).			
Fit in groove			
Top	0.0035	0.005	(Comp.)
Second	0.0035	0.005	(Comp.)
Third	0.0035	0.005	(Comp.)
Fourth	0.001	0.003	(Oil Control)
INTAKE VALVES:			
Stem diameter	0.434	0.435	
Valve guide bore	0.4365	0.4380	
Stem clearance	0.0015	0.0040	
Valve to rocker arm clearance (hot)	0	0	
Hydraulic lifter bleed-down rate (⅛ inch travel) 6 Sec. Min.			
Width of valve seat	3 / 32		1 / 16
Note. Valve face angle is 15 degrees			
EXHAUST VALVES:			
Stem diameter	0.433	0.434	
Valve guide bore	0.4365	0.4380	
Stem clearance in guide	0.0025	0.0050	
Valve to rocker arm clearance (hot)	0		
Hydraulic lifter bleed-down rate (⅛ inch travel) 6 Sec. Min.			
Width of valve seat — inch	3 / 32		⅛
Note. Valve face angle is 15 degrees			
VALVE GUIDE:			
Distance above head (Intake)	1 1 / 16		
Distance above head (Exhaust)	1		
VALVE TAPPET:			
Clearance in block	0.0015	0.0040	
VALVE SPRINGS:			
Free length			
Inner (new)	2 9 / 32		
Outer (new)	2 19 / 32		
Length-valve open			
Inner (new)	1.495		
Outer (new)	1.620		
Lbs. pressure-valve open			
Inner	86	93	
Outer	121	129	
VALVE ROCKER ARM CLEARANCE IN SHAFT	0.0015	0.0040	
VALVE TIMING:			
Intake opens (before TDC)	22°		
Intake closes (after BDC)	58°		
Exhaust opens (before BDC)	62°		
Exhaust closes (after TDC)	18°		
OIL PUMP:			
Body gear end clearance	0.0015	0.009	
Pump body to gear clearance	0.0046	0.0086	

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
OIL PUMP (Continued):			
Pump shaft diameter	0.4905	0.4910	
Pump shaft clearance in bore	0.0015		0.003
Body gear backlash — inch	0.003	0.015	
Note: Oil pressure is from 15 to 55 (Engine at low idle and above 1500, respectively).			
FLYWHEEL HOUSING			
SAE No. 2 Flange			
When assembled on the engine, the large bore of the housing is to be concentric with the crankshaft within .008 inch total indicator reading. The rear face of the housing is to be square with the crankshaft within .008 inch total indicator reading.			
SPARK PLUG:			
Gap, inch	0.028	0.033	
Thread size	14MM		
Hex size	13/16		
CARBURETOR:			
Power jet size tube assembly			No. 28 (1.028)
Power valve channel restriction			No. 54 drill (0.55)
High speed bleed — inch			Pri. No. 68 drill (0.031) Sec, No. 66 drill (0.033)
Asperating hole — inch			0.055 inverted
Idle tubes			84 cc per min.
Idle channel restriction — inch			No. 54 drill (0.055)
Idle discharge hole — inch			No. 55 drill (0.052)
Idle transfer hole — inch			No. 58 drill (0.042)
Idle air bleed — inch			No. 51 drill (0.067)
Main well tube — inch			⅛ dia.
Main well bleed			No. 68 drill (0.031)
Fuel inlet needle seat			0.110
Accelerator pump discharge hole			No. 69 drill (0.0293)
Accelerator pump spring			0.035 wire ¾ O.D. by 2 7/8 long
Manifold drilling	0.070		
Vertical drilling	0.046		
Venturi drilling	0.039		
Venturi bleed — inch	0.029		
Governor spring color marking			
Yellow			
Governor spring position in housing			
No. 1 post			
Governor by-pass jet (top) — inch	0.031		
Governor by-pass jet (bottom) — inch	0.042		
AIR COMPRESSOR:			
Unloading valve stem diameter			0.002
Discharge valve groove			0.003
Crankshaft bearing fit in body	0.003T	0.005T	
Cylinder bore:			
Out of round	0.003	0.003	
Taper	0.003	0.003	
Pistons:			
Clearance in cylinder bore	0.002	0.004	
Piston rings:			
Fit in grooves			
Compression	0.002	0.004	
Oil scraper	0.0035	0.0055	
End gap	0.020	0.020	
Clearance at gap in cylinder	0.010	0.015	
Piston pins:			
Fit in piston	0.0003T	0.0005T	
Clearance in connecting rod bushing	0.0005	0.001	

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimension and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
PISTONS (Continued):			
Connecting rod bearing clearance with crankshaft journal	0.001	0.002	
Crankshaft journal out of round	0.001	0.001	
Crankshaft clearance with oil seal	0.0015	0.0025	
BOOM HOIST SHAFT			
Worm wheel shaft bearing end play	0.003	0.005	0.005
Worm to worm wheel contact			Must be *all* to the left of centerline (para 2-19)
Planetary boom hoist drum			
a. Rope spooling surface in relation to bearing bores (total runout)			⅛ inch
b. Drum surfaces and gear pitch diameter in relation to bearing bores (total runout)			0.003 T.I.R.
Sprockets			
a. Pitch line concentric with spline within			0.006 T.I.R.
b. Hub faces perpendicular within			0.002 T.I.R.
Planetary pinion backlash	0.004	0.006	0.008
Hub and gear backlash	0.004	0.006	0.008
Spacer face parallelism		0.0005	0.002
WORM SHAFT:			
Bearing end play	0.003	0.005	0.005
Large bearing journal	2.1663	2.1665	
Small bearing journal	1.9686	1.9693	
SWING BRAKE MASTER CYLINDER:			
Piston to housing bore			0.007
BOOM SHEAVES AND ROLLERS:			
Sheave bushings (I.D.)	3.011	3.013	
Sheave bushing (O.D.)	3.504	3.506	
Sheave bore	3.500	3.502	
Roller bore	2.375	2.377	
CONTROL STAND MASTER CYLINDERS:			
Piston to housing bore			0.007
GANTRY:			
Peak sheave bore	2.4995	2.5015	
Peak sheave bushing bore	2.2555	2.2575	
Peak pin (small diameter)	2.2470	2.2485	
Spreader sheave bore	2.4995	2.5015	
Spreader bushing bore	2.2555	2.2575	
Spreader pin diameter	2.2470	2.2485	
DRUM PAWL AND SWING LOCK CONTROL:			
Boom hoist drum pawl bore	1.002	1.012	
Front and rear drum pawl bores	0.995	1.000	
Front and rear drum pawl keyway (width)	0.1885	0.1905	
Front and rear drum pawl keyway (depth)	0.0997	0.1047	
Swing lock lever bore	1.002	1.012	
Compression springs (free length)			4¾"
Front and rear drum levers (bore)	0.995	1.000	
Front and rear drum lever keyway (width)	0.1885	0.1905	
Front and rear drum lever keyway (depth)	0.0997	0.1047	
SWING BRAKE ASSEMBLY:			
Swing brake shoes pivot bore	1.252	1.255	
Swing brake pinion shaft (top bearing journal)	2.5580	2.5591	
Swing brake pinion shaft (lower bearing journal)	2.5592	2.5599	
HOOK BLOCK:			
Hook throat diameter			15° increase
Hook twist			10°

Table 1-4. Repair and Replacement Standards (Continued)

Component	Manufacturers Dimensions and tolerances in inches		Maximum allowable wear or clearance
	From	To	Maximum
ENGINE TRANSMISSION:			
Drive gear needle roller side clearance	0.000	0.001	0.001
Outside diameter pilot of mainshaft	.9839	.9835	.982
Inside diameter pilot of main drive	1.5478	1.5484	1.550
Outside diameter pilot of main drive	.9839	.9835	.981
Inside diameter mainshaft bearing bore-case	3.5431	3.5441	3.546
Inside diameter main drive bearing bore-case	3.9370	3.9379	3.940
Inside diameter countershaft front bearing bore-case	2.8346	2.8355	2.838
Outside diameter of countershaft rear bearing surface	1.7500	1.7495	1.748
MAIN DRUMSHAFT ASSEMBLY (FRONT AND REAR):			
Shaft end play	0.003	0.005	
Shaft bearing journal diameters (left to right)	3.3765	3.3775	
	3.7407	3.7413	
	3.7407	3.7413	
	3.3765	3.3775	
Rear axle pinion and gear backlash	0.005	0.015	0.010
STARTER MOTOR:			
Commutator	1.690	1.700	1.621
Slots (Commutator)			0.033
Depth (Slot)	0.025	0.032	

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. Special Tools and Equipment

No special tools and equipment are required to perform Direct Support or General Support Maintenance on the model M320T2 truck crane.

2-2. Specially Designed (Fabricated) Tools and Equipment

No specially designed (fabricated) tools and equipment are required to perform Direct Support or General Support Maintenance on the model M320T2 truck crane.

Section II. TROUBLESHOOTING

2-3. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the model M320T2 truck crane and its components. Probable malfunctions are listed in table 2-1. Each malfunction is followed by a list of probable causes. Recommended corrective action is described opposite the probable cause.

2-4. Troubleshooting

Refer to table 2-1 and troubleshoot the model M320T2 truck crane.

Table 2-1. Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Engine will not crank.	*a.* Corroded battery cables and / or terminals.	*a.* Clean cables and / or terminals.
	b. Batteries discharged.	*b.* Refer to TM 5-3810-294-20 and replace batteries.
	c. Faulty starter relay.	*c.* Refer to TM 5-3810-294-20 and replace relay.
	d. Faulty starter.	*d.* Repair starter (chap. 3).
	e. Engine seized due to operation without proper lubricant or coolant.	*e.* Repair engine as required (chap. 4 and 13).
2. Engine cranks but will not start.	*a.* Out of fuel.	*a.* Fill fuel tank.
	b. Restricted air intake.	*b.* Refer to TM 5-3810-294-10 and service air cleaner.
	c. Interior of distributor cap is wet.	*c.* Refer to TM 5-3810-294-10 and dry interior of distributor cap.
	d. Primary ignition circuit open:	*d.* Refer to TM 5-3810-294-20 and
	(1) Loose primary.	(1) Tighten lead.
	(2) Ignition points dirty or burned.	(2) Clean or replace points.
	(3) Open ignition switch circuit.	(3) Repair circuit.
	e. Primary ignition circuit grounded:	*e.* Refer to TM 5-3810-294-20 and:
	(1) Cracked insulator on primary lead.	(1) Replace lead.
	(2) Ignition points not properly adjusted.	(2) Adjust points.
	(3) Grounded capacitor.	(3) Replace capacitor.
	f. Secondary ignition circuit faulty:	*f.* Refer to TM 5-3810-294-20 and:
	(1) Corroded spark plug cable terminals. Broken or cracked cable insulation.	(1) Clean terminal and / or replace cable insulation.
	(2) Spark plugs damaged or dirty.	(2) Clean or replace plugs.
	(3) Cracked distributor cap.	(3) Replace cap.
	(4) Rotor cracked or rotor contract arm broken.	(4) Replace rotor.
	g. Batteries discharged.	*g.* Refer to TM 5-3810-294-20 and replace batteries.
	h. Improper valve tappet clearance.	*h.* Refer to TM 5-3810-294-20 and adjust valves.
	i. Faulty fuel pump.	*i.* Refer to TM 5-3810-294-20 and replace fuel pump.
	j. Carburetor out of adjustment.	*j.* Refer to TM 5-3810-294-20 and adjust carburetor.
	k. Extremely low compression pressure on one or more cylinders.	*k.* Replace piston rings, pistons, or other engine parts as required (chap. 4 and 13).
	l. Faulty carburetor.	*l.* Repair carburetor (chap. 3 and 12).
3. Engine misfires.	*a.* Fouled spark plugs. Spark plug porcelain cracked.	*a.* Refer to TM 5-3810-294-20 and clean or replace.
	b. Burned or pitted ignition points.	*b.* Refer to TM 5-3810-294-20 and replace points.
	c. Incorrect ignition point gap.	*c.* Refer to TM 5-3810-294-10 and adjust points.
4. Engine idles rough.	*a.* Restricted air intake.	*a.* Refer to TM 5-3810-294-10 and service air cleaner.
	b. Low octane fuel.	*b.* Refer to TM 5-3810-294-10 and drain fuel tank. Fill tank with proper fuel.
	c. Carburetor out of adjustment.	*c.* Refer to TM 5-3810-294-20 and adjust carburetor.
	d. Ignition point gap too narrow or much too wide.	*d.* Refer to TM 5-3810-294-20 and adjust points.
	e. Intake manifold leaks.	*e.* Refer to TM 5-3810-294-20 and repair intake manifold.
	f. Improper valve tappet clearance.	*f.* Refer to TM 5-3810-294-20 and adjust tappets.

***Table 2-1. Troubleshooting* — Continued**

Malfunction	Probable Cause	Corrective Action
5. Engine noisy.	*a*. Low octane fuel.	*a*. Refer to TM 5-3810-294-10 and drain fuel tank. Fill tank with proper fuel.
	b. Excessive tappet clearance.	*b*. Refer to TM 5-3810-294-20 and adjust tappets.
	c. Bearings worn or damaged.	*c*. Knocking, pounding, or similar noises are serious. Locate the sound, and repair or replace the bearings or other parts involved. Any unusual engine sound must be accounted for and corrected.
6. Engine fails to reach operating temperature.	*a*. Thermostat stuck open or removed from vehicle.	*a*. Refer to TM 5-3810-294-20 and replace thermostat.
	b. Defective temperature sending unit or engine control panel gage.	*b*. Refer to TM 5-3810-294-20 and replace defective unit.
7. Engine overheats.	*a*. Rain shutters closed.	*a*. Open rain shutters.
	b. Radiator coolant level low.	*b*. Add coolant.
	c. Engine oil level low.	*c*. Add oil.
	d. Loose radiator hose connections.	*d*. Tighten hose connections. Add coolant as required.
	e. Water pump V-belt loose.	*e*. Refer to TM 5-3810-294-20 and adjust V-belt.
	f. Water pump faulty.	*f*. Refer to TM 5-3810-294-20 and replace water pump.
	g. Collapsed or clogged hoses.	*g*. Refer to TM 5-3810-294-20 and replace hoses.
	h. Defective thermostat.	*h*. Refer to TM 5-3810-294-20 and replace thermostat.
	i. Radiator leaks or is clogged.	*i*. Refer to TM 5-3810-294-20 and replace radiator.
	j. Engine leaking oil: (1) Oil filter leaks. (2) Leakage at any external piping.	*j*. Refer to TM 5-3810-294-20 and: (1) Replace oil filter. (2) Replace piping.
	k. Excessive engine internal friction or excessive load on engine, due to excess friction in driven items, such as transmission.	*k*. This is a serious condition which can be corrected only by overhaul of the item which is faulty. Determine cause and overhaul the overheated binding assembly.
8. Low oil pressure.	*a*. Engine oil level low.	*a*. Add oil.
	b. Loose connections in oil lines.	*b*. Tighten oil line connections.
	c. Oil filter clogged.	*c*. Refer to TM 5-3810-294-20 and change oil filter.
	d. Oil too thin due to dilution or too light a grade used.	*d*. Drain crankcase and refill with proper oil.
	e. Faulty oil pressure sender.	*e*. Refer to TM 5-3810-294-20 and replace oil pressure sender.
	f. Worn main bearings, connecting rod bearings, or excessive clearance in other engine parts.	*f*. Repair engine as required (chap. 4 and 13).
9. High oil pressure.	*a*. Oil too heavy.	*a*. Drain crankcase and refill with proper oil.
	b. Defective oil pressure gage on engine control panel.	*b*. Refer to TM 5-3810-294-20 and replace oil pressure gage.
10. Excessive oil consumption	*a*. Oil leaks.	*a*. Check oil lines. Tighten any loose connections.
	b. Poor quality or wrong grade of oil.	*b*. Drain crankcase and refill with proper oil.
	c. Clogged oil pressure relief passage (causing back pressure in crankcase).	*c*. Clean oil pressure relief passage.
	d. Broken or worn valves, rings, pistons, or connecting rod bearings, or stuck valves.	*d*. Refer to TM 5-3810-294-20 and check compression. Repair or replace rings and/or valves as required (chap. 4 and 13). Free valves and replace faulty valves,

Table 2-1. Troubleshooting — Continued

Malfunction	Probable Cause	Corrective Action
		springs, or valve guides as required (chap. 4 and 13).
11. Engine lacks power	*a.* Fuel filter is clogged.	*a.* Refer to TM 5-3810-294-10 and service fuel filter.
	b. Restricted air intake.	*b.* Refer to TM 5-3810-294-10 and service air cleaner.
	c. Fuel pump not operating properly.	*c.* Refer to TM 5-3810-294-20 and replace fuel pump.
	d. Dirty or faulty carburetor.	*d.* Refer to TM 5-3810-294-20 and clean or replace carburetor.
	e. Faulty spark plugs.	*e.* Refer to TM 5-3810-294-20 and replace plugs.
	f. Ignition points burned, pitted, or sticking.	*f.* Refer to TM 5-3810-294-20 and replace points.
	g. Faulty ignition or timing.	*g.* Refer to TM 5-3810-294-20 and inspect and/or replace points, plugs, and other ignition components.
	h. Excessive load on engine.	*h.* This is a serious condition which can be corrected only by overhaul of the item which is faulty. Determine cause and overhaul the overheated binding assembly.
	i. Clutch slipping.	*i.* Refer to TM 5-3810-294-20 and adjust clutch. Replace clutch drive plate lining (chap. 14, sec. III.)
	j. Broken or worn valves or piston rings.	*j.* Refer to TM 5-3810-294-20 and check compression. Repair or replace rings and/or valves as required (chap. 4 and 13).
	k. Valves stuck (open or closed) in valve guides.	*k.* Free valves and replace faulty valves, springs, or valve guides as required (chap. 4 and 13).
	l. Improper fuel mixture.	*l.* Repair carburetor or fuel pump (chap. 3 and 12).
12. Engine "cuts out" suddenly under load.	*a.* Dirty fuel or fuel tank.	*a.* Refer to TM 5-3810-294-10 and drain fuel tank. Refill with proper fuel.
	b. Restricted fuel line.	*b.* Refer to TM 5-3810-294-20 and replace line.
	c. Faulty fuel pump.	*c.* Refer to TM 5-3810-294-20 and replace fuel pump.
13. Engine tends to stall at full load.	*a.* Fuel filter is clogged.	*a.* Refer to TM 5-3810-294-10 and service fuel filter.
	b. Restricted air intake.	*b.* Refer to TM 5-3810-294-10 and service air cleaner.
	c. Faulty fuel pump.	*c.* Refer to TM 5-3810-294-20 and replace fuel pump.
14. Engine exhaust is smoky.	*a.* If exhaust is black, incomplete fuel combustion due to poor spark plugs or ignition timing.	*a.* Refer to TM 5-3810-294-20 and replace spark plugs and adjust ignition timing.
	b. If exhaust is blue, the engine is burning oil due to leaking oil into exhaust manifold or blow-by past piston rings.	*b.* Repair engine as required (chap. 4 and 13).
15. Engine overspeeds.	Incorrect engine speed governor adjustment.	Refer to TM 5-3810-294-20 and adjust speed governor.
16. Engine clutch overheats or jumps out of engagement.	*a.* Improper clutch adjustment.	*a.* Refer to TM 5-3810-294-20 and adjust clutch.
	b. Clutch plates worn.	*b.* Repair clutch (chap 14).
17. Batteries discharge with engine running.	*a.* Loose connections.	*a.* Tighten connections.
	b. Alternator V-belt loose.	*b.* Refer to TM 5-3810-294-10 and adjust V-belt tension.
	c. Faulty alternator.	*c.* Refer to TM 5-3810-294-20 and replace alternator.

Table 2-1. Troubleshooting — Continued

Malfunction	Probable Cause	Corrective Action
	d. Brushes worn.	*d.* Replace brushes (chap. 3).
	e. Alternator "single phasing" due to burned out rectifier or rectifiers.	*e.* Refer to TM 5-3810-294-20 and replace alternator or repair alternator (chap. 3).
18. Incorrect alternator voltage.	*a.* Faulty alternator.	*a.* Refer to TM 5-3810-294-20 and replace alternator.
	b. Faulty voltmeter.	*b.* Refer to TM 5-3810-294-20 and replace meter.
19. Starter does not rotate or rotates slowly.	*a.* If lights go out or dim: weak battery or poor connections.	*a.* Refer to TM 5-3810-294-10 and / or TM 5-3810-294-10 to correct battery problem.
	b. If lights stay bright: faulty starter switch.	*b.* Replace starter components as necessary (chap. 3).
20. Starter rotates but does not engage flywheel.	*a.* Pinion stuck, pinion teeth broken, or faulty solenoid.	*a.* Repair and / or replace faulty item (chap. 3).
	b. Ring gear teeth broken.	*b.* Replace ring gear (chap. 3).
21. Power steering is "spongy" and makes "groaning" sound.	*a.* Low fluid level.	*a.* Refer to TM 5-3810-294-20 and add fluid.
	b. Faulty power steering pump.	*b.* Refer to TM 5-3810-294-20 and replace pump.
	c. Mechanical linkage binding.	*c.* Adjust or repair linkage (chap. 16).
22. Hard steering when vehicle is standing: or trouble is intermittent.	*a.* Hydraulic fluid level low.	*a.* Refer to TM 5-3810-294-10 and fill reservoir to proper level.
	b. Pump belt loose or glazed.	*b.* Refer to TM 5-3810-294-20 and adjust or replace belt.
	c. Tires worn, unbalanced wheels, wrong air pressure, out of alinement.	*c.* Refer to TM 5-3810-294-10 and / or TM 5-3810-294-20 to correct steering problem.
23. Hard steering when vehicle is moving.	*a.* Reservoir too full.	*a.* Refer to TM 5-3810-294-10 and remove fluid until proper level is reached.
	b. Filter clogged.	*b.* Refer to TM 5-3810-294-20 and replace reservoir or clean filter.
24. Brakes "grab" or the vehicle tends to turn when brakes are applied (pulls to one side).	*a.* Improper brake adjustment.	*a.* Refer to TM 5-3810-294-20 and adjust brakes.
	b. Worn brake linings.	*b.* Replace brake shoes (chap. 18).
25. Incorrect air brake system pressure.	*a.* Leaks in system.	*a.* Check for leaks and tighten loose connections.
	b. Defective compressor.	*b.* Refer to TM 5-3810-294-20 and replace compressor.
	c. Governor set at wrong pressure range.	*c.* Refer to TM 5-3810-294-20 and adjust governor.
26. Lights fail or are dim.	*a.* Defective or burned out lamps.	*a.* Refer to TM 5-3810-294-20 and replace lamps.
	b. Loose connections or defective wiring.	*b.* Tighten connections and repair and / or replace wiring.
	c. Defective switches.	*c.* Refer to TM 5-3810-294-20 and replace switches.
	d. Faulty ground.	*d.* Clean ground terminals.
27. Crane will not lift rated capacity.	*a.* Front or rear drum clutches are slipping.	*a.* Refer to TM 5-3810-294-10 and adjust drum clutches.
	b. Engine not delivering full power.	*b.* Perform procedures listed in step 11.
28. Boom will not lower.	*a.* Safety pawl is engaged.	*a.* Lift boom slightly, disengage safety pawl and lower boom.
	b. Boom hoist pawl friction shoes improperly adjusted or linkage improperly adjusted.	*b.* Refer to TM 5-3810-294-20 and adjust shoes and / or linkage.
29. Boom will not raise.	*a.* Boom already in highest position.	*a.* Lower boom.
	b. Boom hoist clutch is slipping.	*b.* Refer to TM 5-3810-294-10 and adjust boom hoist clutch.
30. Clamshell operates erratically.	*a.* Rear drum brake is lagging.	*a.* Refer to TM 5-3810-294-10 and adjust rear drum shaft.
	b. Front or rear drum clutches are slipping or grabbing.	*b* Refer to TM 5-3810-294-10 and adjust drum clutches.

Table 2-1. Troubleshooting — Continued

Malfunction	Probable Cause	Corrective Action
	c. Improper lubrication of bucket hinges.	*c*. Lubricate bucket hinges.
31. Dragline not operating properly.	*a*. Dump cable not adjusted properly.	*a*. Refer to TM 5-3810-294-10 and adjust dump cable.
	b. Front or rear drum brakes improperly adjusted.	*b*. Refer to TM 5-3810-294-10 and adjust drum brakes.
	c. Fairlead rollers or sheaves are sticking.	*c*. Lubricate rollers and / or sheaves.
32. Shovel not operating properly.	*a*. Front or rear drum brakes improperly adjusted.	*a*. Refer to TM 5-3810-294-10 and adjust drum brakes.
	b. Dipper pitch brace improperly adjusted.	*b*. Refer to TM 5-3810-294-10 and adjust dipper pitch brake.
33. Backhoe not operating properly.	*a*. Front or rear drum brakes improperly adjusted.	*a*. Refer to TM 5-3810-294-10 and adjust drum brakes.
	b. Dipper pitch incorrect.	*b*. Refer to TM 5-3810-294-10 and adjust dipper pitch.
	c. Cable is out of sheave.	*c*. Place cable in sheave.
34. Pile driver not operating properly.	*a*. Front or rear drum brakes improperly adjusted.	*a*. Refer to TM 5-3810-294-10 and adjust drum brakes.
	b. Hammer binding on pile leads.	*b*. Lubricate hammer.
35. Hard or excessive lever or pedal operation.	*a*. Lack of lubrication.	*a*. Lubricate levers and pedals.
	b. Improper adjustment.	*b*. Refer to TM 5-3810-294-10 and / or TM 5-3810-294-20 to adjust lever and pedals.
36. Revolving frame will not swing.	*a*. Swing brake and / or swing lock are engaged.	*a*. Disengage swing brake and / or swing lock.
	b. Swing clutch improperly adjusted.	*b*. Refer to TM 5-3810-294-10 and adjust swing clutch.
	c. Swing shaft broken.	*c*. Replace shaft (chap. 5).
37. Revolving frame teeters.	*a*. Hook rollers improperly adjusted.	*a*. Refer to TM 5-3810-294-20 and adjust hook rollers.
	b. Hook roller parts excessively worn.	*b*. Repair hook rollers (chap. 8).
38. Any side stand mounted shaft shows signs of grease or oil leakage.	*a*. Faulty oil seals.	*a*. Refer to the paragraphs which describe component removal and remove the component. Overhaul and replace the seal or seals.

Section III. GENERAL MAINTENANCE

2-5. General Disassembly Instructions

The following points should be kept in mind during the disassembly of any component.

a. Disassembly should be limited to that required for specific repairs. Never disassemble an assembly beyond the point necessary to fix the trouble.

b. Never use heat from a torch to assist in removing parts unless the parts to be heated are already damaged beyond repair. Excessive heat will damage the parts beyond repair.

c. Never use more force than necessary while dismantling an assembly. In most cases, a great deal of force is not required.

2-6. General Inspection Instructions

When any major component has been removed and disassembled, all parts should be inspected for wear or damage. Particular attention should be paid to the following items.

a. Clean all parts thoroughly, using kerosene, diesel oil, or a suitable commercial solvent. Never use a hot alkaline solution on finished parts or bearings.

b. Inspect all gears for worn, cracked, or broken teeth.

c. Inspect all bushings for wear, scoring, or galling.

d. Replace all oil seals and O -rings.

e. Replace all gaskets, making sure the replacement gaskets are of the same thickness as the old gasket. Use gasket material of the same composition.

f. Inspect all anti-friction bearings for excessive play, distorted races, and roller wear or damage. Prepack all anti-friction bearings with a good grade of bearing grease before reassembly.

g. Smooth out ridges on shafts caused by wear. Be particularly careful to inspect all surfaces on which seal lips seat. These surfaces must be very smooth to prevent wearing away the seal lips, which will cause oil or grease leaks.

h. Inspect all threaded items and replace those with damaged threads.

i. Inspect all other parts for any evidence of damage. Replace or repair any part which is in questionable condition. The cost of the part is often minor in comparison with the cost of redoing the job if the part should fail.

2-7. General Reassembly Instructions

The following points should be kept in mind when reassembling any component of this machine.

a. When torque values are specified, be sure to use a torque wrench and tighten as directed.

b. Always prepack anti-friction bearings with suitable bearing grease before final assembly.

c. If a bearing is to be heated for assembly purposes, the entire bearing should be immersed in an oil bath, or heated in an oven, for sufficient time to ensure that it is heated throughout.

d. Never force a bearing on a shaft if the fit appears to be so tight that the inner race will be distorted. Either polish the shaft seat or heat the bearing, or do both.

e. Inspect all grease passages to be sure they are open and clean.

f. Smooth out all nicks, burrs, or galled spots on shafts, bores, pins or bushings.

g. Check the fit of keys in keyways. File or grind the key, if necessary, to make sure it fits without interference.

h. Roller bearing spacers must be reassembled in the bearing from which they were removed. They are ground to fit individual bearings.

2-8. Brake Band Repair

The only repair possible for brake bands is lining replacement. Linings are all of the riveted type, and all are repaired by drilling out the rivets, installing a new lining, and riveting it in place. All linings must be replaced when they reach a point where the lining covers the rivet at the point of most lining wear, by 1 / 16 inch or less.

2-9 Welding Procedure for "T-1" Steel

a. General. The upper turret flange is the only place in this machine where high strength "T-1" steel is used. The following instructions cover the methods to be used in welding this high strength alloy steel.

b. Electrode Selection. The single most important thing to remember in the welding of high strength steels is to use the right electrode. Be sure to use only electrodes with "low-hydrogen" coatings for manual arc welding. An alternative method would be to use a welding method, such as inert gas shielded arc, or submerged arc, which is inherently "low-hydrogen." Hydrogen is the main cause of failure in welding high strength alloy steel. Hydrogen which remains in the weld will cause cracking when the welded steel cools. This cracking is not visible at the surface of the weld, but will occur beneath the visible surface. In order to insure the use of low-hydrogen rods, use rods with classification numbers ending in 15, 16, 18, or 28. No other rods are acceptable. Samples of acceptable rods are E7028, E8015, E9016, and E11018. Note that all of these numbers end in one of the four sets of 2 digits previously mentioned. When welding "T-1" steel to a lower strength steel, the electrode strength should be the same as recommended for the lower strength steel, but mu remain of the low-hydrogen type. Also, when do g submerged-arc or inert-gas welding, the wire or wire-flux combination need only match the lower strength steel. Correct handling of electrodes, fluxes, and shielding gases is also very important. Low-hydrogen coated electrodes and fluxes, when exposed to the air, will pick up moisture. Damp electrodes and fluxes are excellent sources of hydrogen. Moist coatings will generate underbead cracking, even though, when dry, they are classified as "low-hydrogen". So, in addition to choosing the right electrodes and fluxes, you must take steps to keep them dry once the container is opened. Regarding covered electrodes, never take the low hydrogen label for granted. Make sure the electrodes are dry as follows:

(1) If your electrodes are in an undamaged metal container and you are sure the container was air tight before opening, put the electrodes immediately into a ventilated holding oven set at 250 / 300° F. Note that moisture control in E70 rods is not as good as in higher strength rods, and it is therefore particularly important that these rods be baked before use.

(2) If the electrode can was not air tight, or if the package was a cardboard "moisture-proof" box, place the electrodes in a baking oven. If possible, check with the electrode supplier for the correct baking temperature and time. If not possible, one hour at 800° F is average. Baking at 800° F should never exceed one hour and 15 minutes. Be sure the oven is vented for air circulation. After baking the electrodes should be placed, while still warm, in a holding oven at 250 / 300° F.

(3) Never take more than a half-hour's supply of electrodes from the holding oven. If electrodes are out of the holding oven longer than one-half hour, repeat step 2.

(4) The following table 2-2 should be used to establish proper current-voltage settings.

Table 2-2. Current-Voltage Settings

Electrode Size	Current (amperes)	Voltage
1 / 8 x 14	140	22
3 / 32 x 14	200	22
3 / 16 x 14	250	24
7 / 32 x 18	300	24

c. Heat. The production of acceptable quality welds in "T-1" steel depends on never exceeding a certain maximum heat. Use less heat than is required for ordinary steels, so that the weld area will cool down rather quickly. As long as "T-1" steel can cool rapidly it will develop good, tough welds. There is only one practical way to control the time required for cooling. That way is to control the amount of heat put into the weld. Table 2-3 is provided to spell out the recommended preheat and interpass temperatures for the thickness of upper turret flange steel provided on this machine.

d. Welding Procedures. The straightforward stringer bead method is preferred for welding "T-1" steel. Do not use the "full weave" method, except as described below. Normally, the proper method is to fill the groove with a succession of stringer beads. In the event that a vertical weld is required, it is permissible to weave, but be sure to restrict the weave to a minimum of two electrode diameters. Before another bead can be laid over an earlier bead, flux, scale, or oxidation must be removed from the earlier bead, which is only good practice for any welding. Do this by the usual powered or manual brush and hammer methods. To prevent porosity at points where you strike the arc with low hydrogen electrodes, strike the arc about one inch from the end of the previous weld increment and back-step into the crate rather than drag the arc down over the crater as you do with other electrodes. This procedure will help to insure that your weld will pass x-ray test standards. The preferred method of back-gouging is arc-air gouging, followed by clean-up grinding. The use of proper air pressure and current generally minimises carbon deposits. However, if back gouging is done improperly, troublesome carbon deposits may be left in the joint. Grinding to 1 / 16 below the exposed surface will normally remove the carbon deposits.

Caution: Do not use an oxyacetylene torch to remove carbon deposits. There is danger of overheating, which may cause an unsatisfactory joint.

Table 2-3. Suggested Minimum (1) And Maximum Preheat Temperatures For "T-1" Steel

Plate thickness (inches)	Manual metal arc process	Inert-gas metal-arc process (2)	Submerged arc process	
			Alloy wire neutral flux (3)	Carbon steel wire alloy flux (4)
Between 1 and 2"	150	150	200	300

(1) A preheat temperature above the minimum shown may be required for highly restrained welds. However, preheat or interpass temperature should never exceed 400° F for steels through 1½ inch, and 450° F above 1½ inch.

(2) Example: Airco A-632 wire and argon with 1 percent oxygen

(3) Example: Linde Oxweld 100 wire and 709-5 flux

(4) Example: Lincoln L61 wire and A6068 X 10 flux

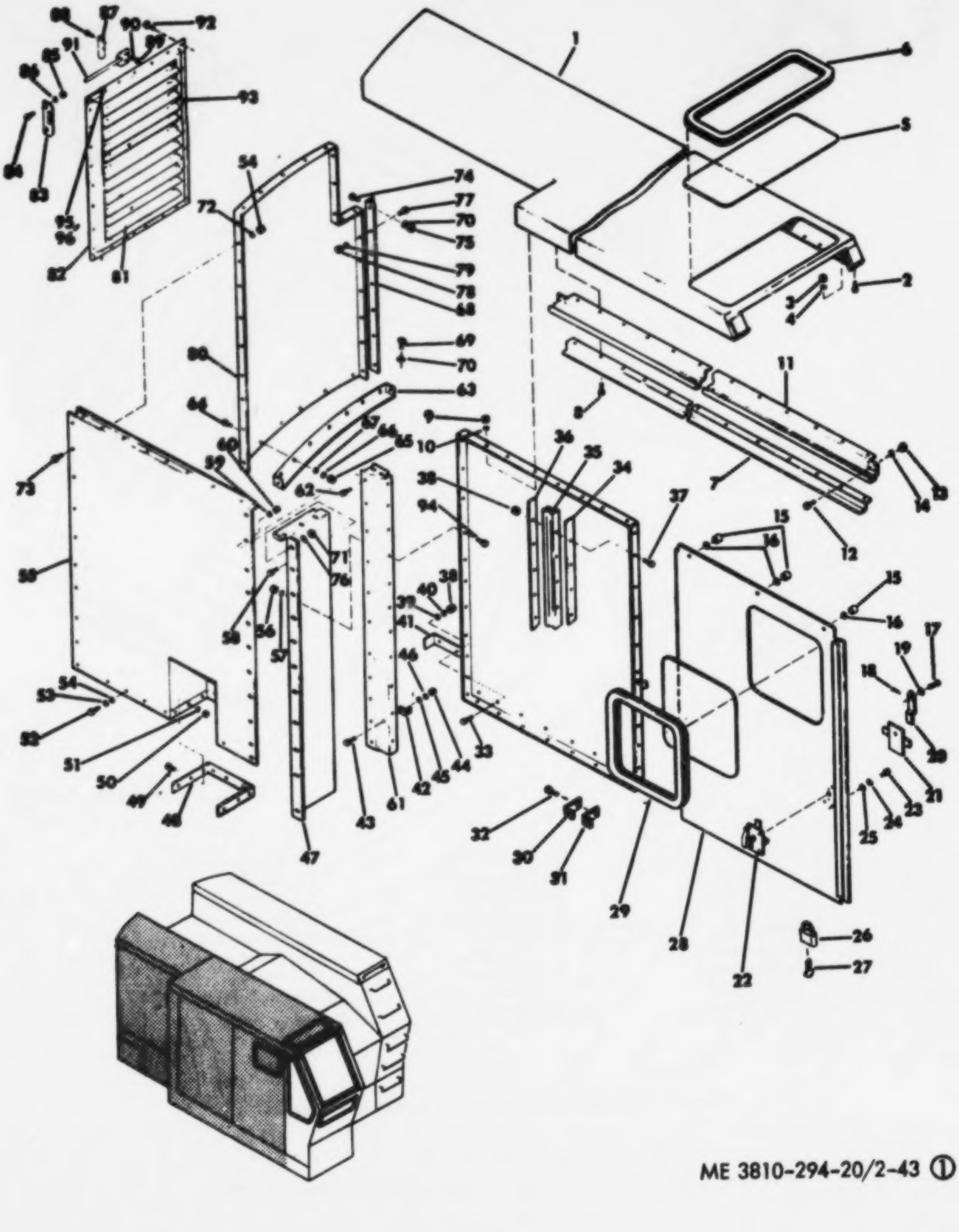
Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

2-10. General

All major components of the crane (revolving frame) of the model M320T2 truck crane are listed in the following paragraphs. Removal and installation of all these components, with the exception of the boom, require removal and reinstallation of some sheet metal in the cab assembly. In all cases, it is to be understood that cab sheet metal, as required, is to be removed as shown in figure 2-1 prior to removal of any major assembly listed.

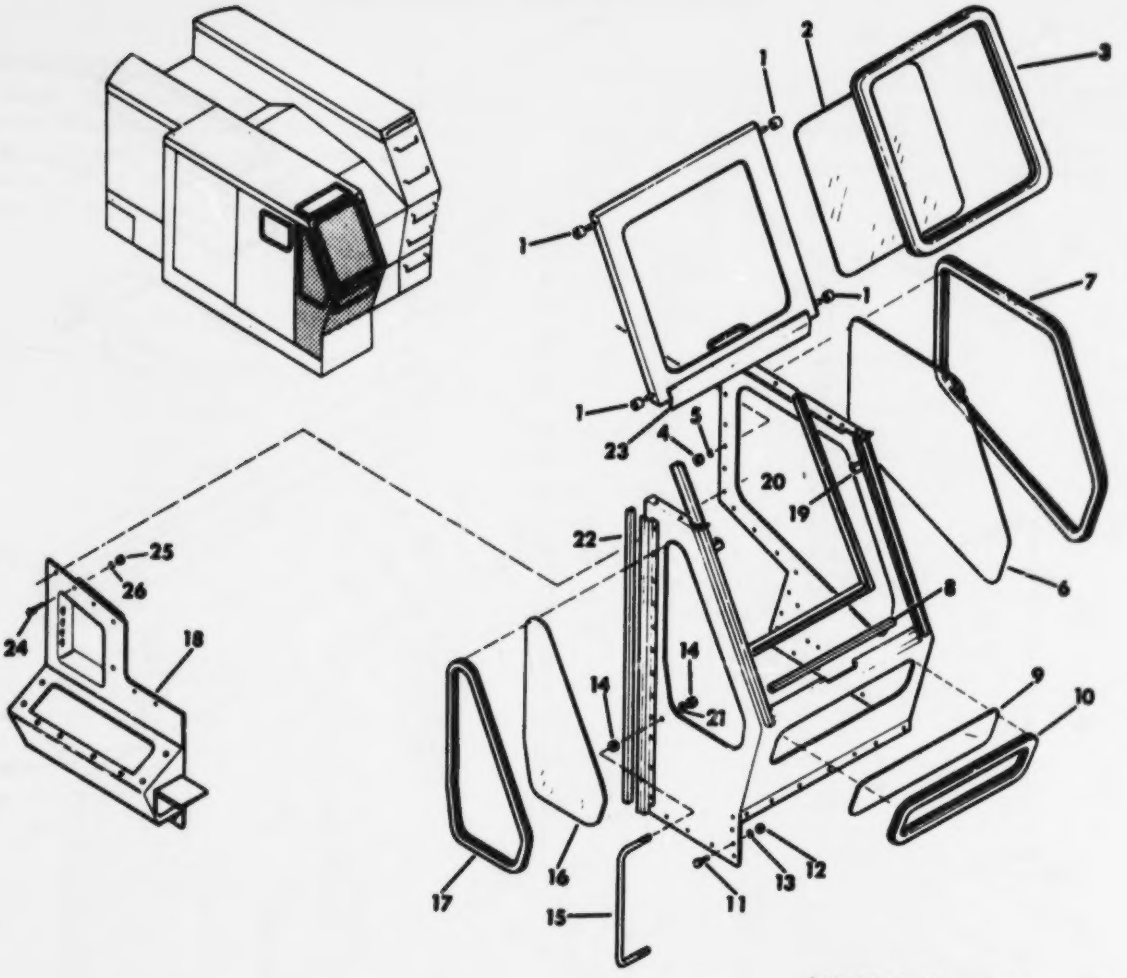
KEY to fig. 2-1 ①

1. Canopy
2. Hex capscrew (30)
3. Nut (30)
4. Lockwasher (30)
5. Safety glass
6. Weather strip
7. Guide
8. Capscrew (17)
9. Nut (17)
10. Lockwasher (17)
11. Rain gutter
12. Capscrew (8)
13. Nut (8)
14. Lockwasher (8)
15. Ball bearing (3)
16. Washer (3)
17. Capscrew (4)
18. Lockwasher (4)
19. Cotter pin
20. Handle
21. Latch
22. Handle
23. Machine screw (2)
24. Lockwasher (2)
25. Capscrew (4)
26. Lock
27. Key
28. Safety glass
29. Weather strip
30. Backup strip
31. Rubber seal strap
32. Roundhead machine screw (3)
33. Capscrew (8)
34. Backup strip
35. Rubber seal strap
36. Shim
37. Machine Screw (13)
38 Nut (8)
39. Flat washer (8)
40. Lockwasher (8)
41. Mounting plate
42. Bracket
43. Capscrew
44. Nut
45. Flat washer
46. Lockwasher
47. Extension panel
48. Mounting plate
49. Capscrew (9)
50. Nut (9)
51. Lockwasher (9)
52. Capscrew (6)
53. Flat washer (24)
54. Lockwasher (24)
55. Rear side panel
56. Nut (11)
57. Lockwasher (11)
58. Capscrew (14)
59. Lockwasher (14)
60. Nut (14)
61. Side panel
62. Capscrew (23)
63. Mounting bracket
64. Capscrew (9)
65. Nut (9)
66. Flat washer (9)
67. Lockwasher (9)
68. Angle
69. Capscrew (7)
70. Lockwasher (35)
71. Nut (23)
72. Nut (18)
73. Capscrew (18)
74. Capscrew (28)
75. Nut (28)
76. Lockwasher (23)
77. Capscrew (7)
78. Nut (7)
79. Lockwasher (7)
80. Rear panel
81. Louver (6)
82. Louver bracket (6)
83. Positioning plate
84. Capscrew (2)
85. Nut (2)
86. Lockwasher (2)
87. Control lever
88. Capscrew (2)
89. Nut (2)
90. Lockwashers (2)
91. Actuating arm
92. Capscrew (16)
93. Shutter
94. Capscrew (11)
95. Operating rod
96. Ball joint (2)


88
87
90
92
91
89
85
86
93
84
83
95, 96
82
81
54
72
74
77
70
75
79
78
68
80
69
70
63
64
60
59
73
67
66
65
9
10
62
1
6
5
2
3
4
11
8
7
13
14
12
36
35
34
38
94
37
15
16
15
16
17
19
18
20
21
23
24
25
55
71
76
40
38
39
41
58
56
57
46
42
45
44
33
43
61
47
54
53
52
51
50
49
48
32
30
31
29
28
22
26
27

ME 3810-294-20/2-43 ①

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 1 of 6).


1
2
3
1
1
7
1
23
4
5
20
19
22
25
26
24
18
8
6
14
14
21
9
10
17
16
15
11
13
12
ME 3810-288-35/2-1 ②

1. Roller (4)
2. Safety glass
3. Weather strip
4. Nut
5. Lockwasher
6. Safety glass
7. Weather strip
8. Rubber strip
9. Safety glass
10. Weather strip
11. Capscrew (19)
12. Nut (19)
13. Lockwasher (19)
14. Nut (4)
15. Cab handle
16. Safety glass
17. Weather strip
18. Control box
19. Fastener (4)
20. Bracket
21. Washer (5)
22. Rubber strip
23. Rubber strip
24. Capscrew (12)
25. Nut (12)
26. Lockwasher (12)

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 2 of 6).

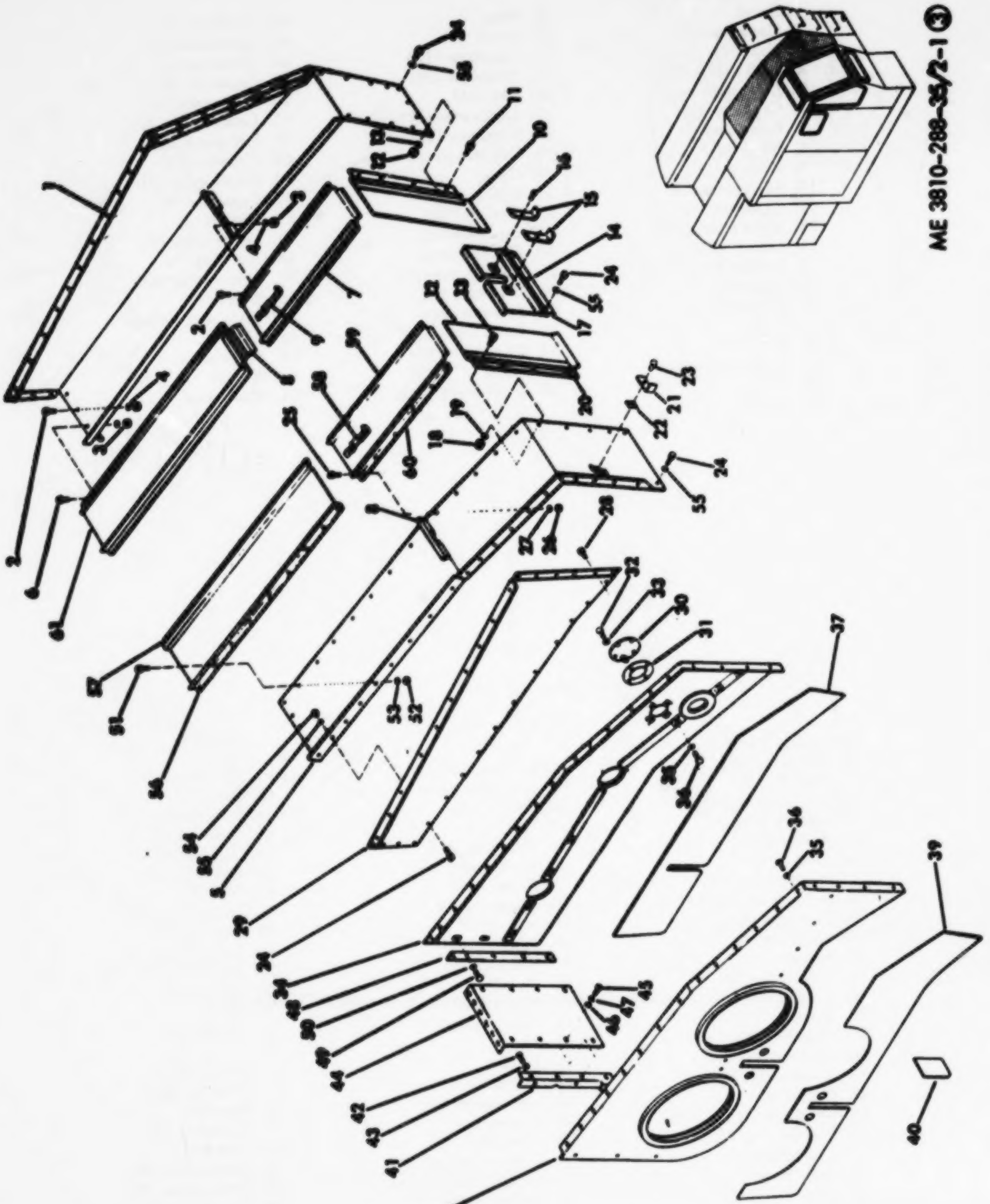

ME 3810-288-35/2-1 (3)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 3 of 6).

KEY to fig. 2-1 ③

1. Panel
2. Capscrew (30)
3. Nut (30)
4. Lockwasher (30)
5. Left center cover
6. Capscrew (9)
7. Front cover
8. Hinge (2)
9. Rivet
10. Left front cover
11. Capscrew (4)
12. Right front cover
13. Capscrew (4)
14. Bottom front cover
15. Latch (2)
16. Rivet (2)
17. Hinge
18. Nut (4)
19. Lockwasher (4)
20. Hinge
21. Latch
22. Shim
23. Rivet
24. Capscrew (12)
25. Capscrew (24)
26. Nut (24)
27. Lockwasher (24)
28. Capscrew (26)
29. Left side panel
30. Cover
31. Gasket
32. Oval stud (4)
33. Grommet (4)
34. Left enclosure
35. Lockwasher (13)
36. Capscrew (13)
37. Left side plate
38. Right enclosure
39. Right side plate
40. Cover
41. Right panel angle
42. Capscrew (3)
43. Lockwasher (3)
44. Center panel
45. Capscrew (8)
46. Flat washer (8)
47. Lockwasher (8)
48. Left panel angle
49. Capscrew (2)
50. Lockwasher (2)
51. Capscrew (9)
52. Nut (9)
53. Lockwasher (9)
54. Nut (26)
55. Lockwasher (38)
56. Hinge
57. Right center cover
58. Rivet
59. Front cover
60. Hinge
61. Rear cover

KEY to fig. 2-1 ④

1. Capscrew (36)
2. Nut (36)
3. Lockwasher (44)
4. Backup strip
5. Rubber strip
6. Shim
7. Machine screw (11)
8. Self-locking nut (11)
9. Capscrew (8)
10. Capscrew (8)
11. Nut (8)
12. Flat washer (8)
13. Lockwasher (8)
14. Bracket
15. Capscrew (9)
16. Lockwasher (31)
17. Cover plate (2)
18. Gasket (2)
19. Capscrew (14)
20. Nut (8)
21. Lockwasher (8)
22. Left canopy
23. Lockwasher (52)
24. Gutter
25. Guide
26. Capscrew (4)
27. Lockwasher (4)
28. Capscrew (8)
29. Capscrew (13)
30. Nut (13)
31. Lockwasher (13)
32. Left front panel
33. Cab handle
34. Nut (4)
35. Capscrew (12)
36. Lockwasher (30)
37. Cover latch
38. Capscrew 18
39. Nut (52)
40. Sliding door
41. Rubber strip
42. Handle
43. Machine screw (2)
44. Lockwasher (2)
45. Plate
46. Latch
47. Capscrew (4)
48. Lockwasher (4)
49. Cotter pin
50. Wing nut (4)
51. Lockwasher (4)
52. Bottom engine cover
53. Backup strip
54. Rubber seal
55. Machine screw (3)
56. Angle
57. Nut (16)
58. Lockwasher (16)
59. Bottom panel
60. Mounting plate
61. Capscrew (14)
62. Nut (14)
63. Lockwasher (14)
64. Ball bearing (2)
65. Flat washer (2)
66. Capscrew (8)
67. Nut (8)
68. Lockwasher (8)
69. Nut (2)
70. Lockwasher (2)
71. Machine screw (2)
72. Spring lock
73. Cover
74. Gasket (2)
75. Cover (2)
76. Rear panel
77. Thumb screw
78. Bracket
79. Capscrew (9)
80. Nut (9)
81. Flat washer (9)
82. Lockwasher (9)
83. Capscrew (20)
84. Nut (20)
85. Flat washer (20)
86. Capscrew (7)
87. Nut (7)
88. Lockwasher (7)
89. Capscrew (22)
90. Nut (22)

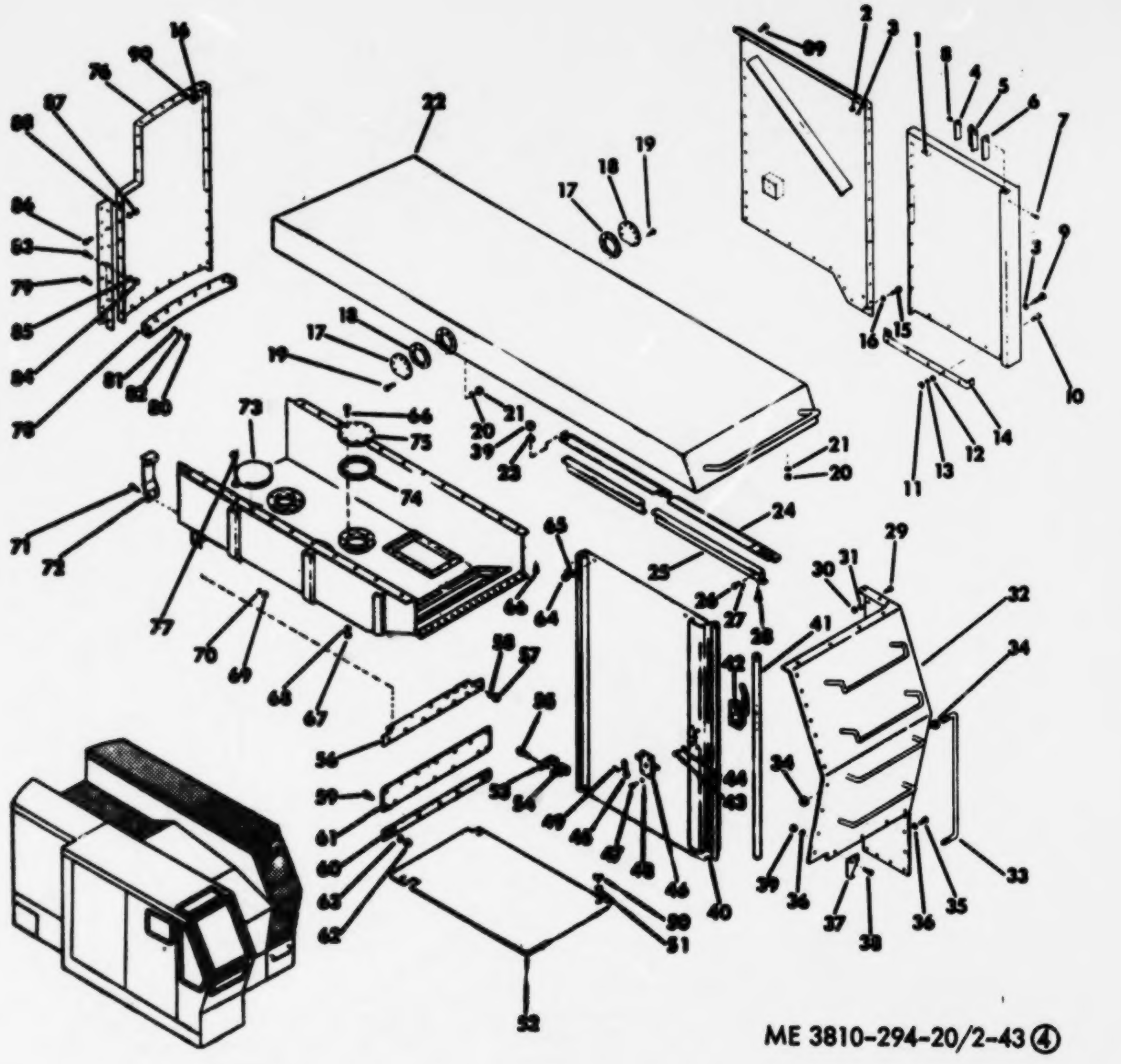
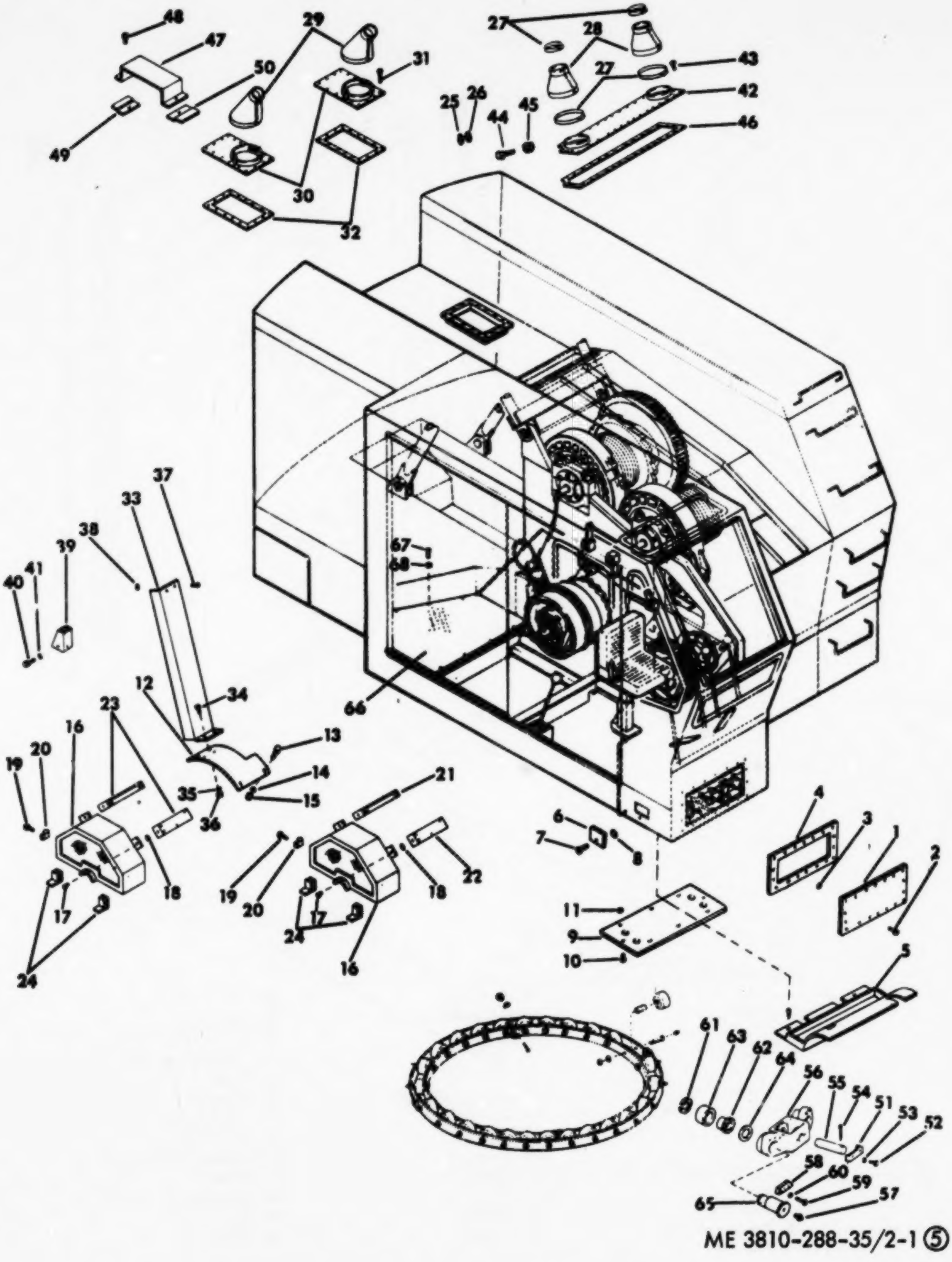

89
2
3
1
8
4
5
6
7
22
19
18
17
9
3
16
15
10
14
12
13
11
21
20
16
90
76
87
88
86
53
79
85
84
81
82
80
78
18
17
19
66
75
21
20
39
23
74
73
71
72
77
70
69
68
67
24
25
65
64
66
26
27
28
29
31
30
32
41
42
34
33
58
57
56
55
53
54
59
61
60
63
62
49
48
47
46
45
44
43
40
34
39
36
37
38
36
35
50
51
52
ME 3810-294-20/2-43 ④

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 4 of 6).

KEY to fig. 2-1 ⑤

1. Cover
2. Fastener (16)
3. Plastic washer (16)
4. Gasket set
5. Dirt trough
6. Cover
7. Fastener
8. Plastic washer
9. Cover
10. Fastener (8)
11. Plastic washer (8)
12. Cover
13. Capscrew (4)
14. Lockwasher (4)
15. Nut (4)
16. Guard assembly (2)
17. Fastener (2)
18. Plastic washer (2)
19. Capscrew (2)
20. Loop clamp (2)
21. Bracket
22. Bracket
23. Bracket (2)
24. Bracket (4)
25. Flat washer
26. Flat washer
27. Boot clamp (8)
28. Gantry boot (8)
29. Gantry boot (2)
30. Cover (2)
31. Machine screw (16)
32. Gasket
33. Cover
34. Capscrew (2)
35. Lockwasher (2)
36. Nut (2)
37. Fastener (4)
38. Plastic washer (4)
39. Cable cover
40. Capscrew (4)
41. Lockwasher (4)
42. Cab cover
43. Machine screw (29)
44. Machine screw (4)
45. Self-locking nut (4)
46. Gasket assembly
47. Cover
48. Capscrew
49. Bracket
50. Bracket
51. Retainer plate (3)
52. Capscrew (6)
53. Lockwasher (6)
54. Cotter pin (3)
55. Pin (3)
56. Swivel arm (3)
57. Lube fitting (6)
58. Lock plate (6)
59. Capscrew (12)
60. Lockwasher (12)
61. Split retainer (6)
62. Hook roller (6)
63. Sleeve bearing
64. Thrust washer (6)
65. Eccentric pin (6)
66. Floor plate
67. Machine screw (6)
68. Flat washer

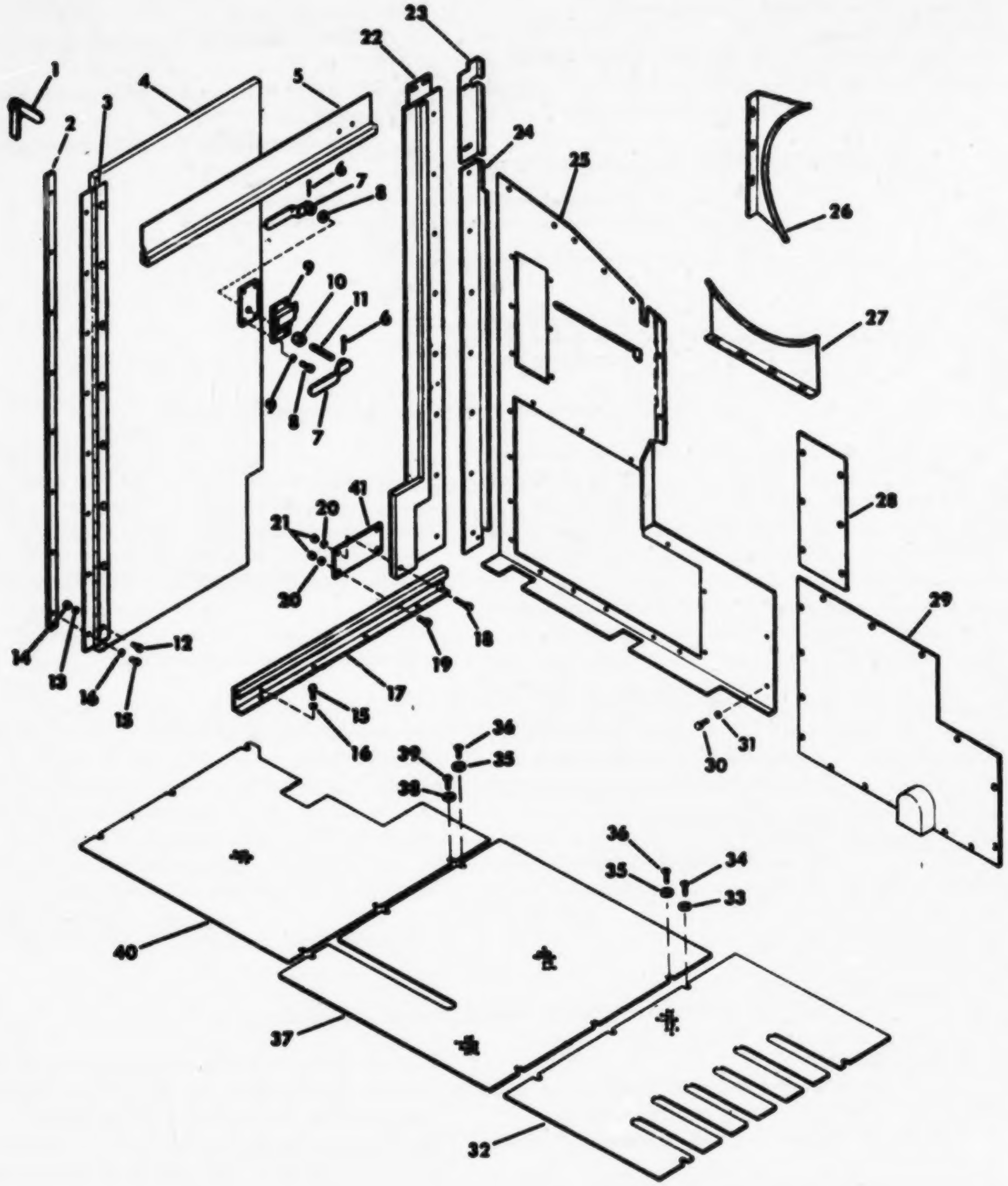

48
27
29
47
31
28
43
50
27
42
25
26
44
45
46
49
30
32
37
33
38
39
40
41
67
68
66
12
34
23
16
20
19
13
14
35
15
36
21
6
7
8
4
3
1
2
18
22
19
20
18
11
9
10
17
24
17
24
16
24
5
61
63
62
64
56
55
54
51
53
52
58
60
59
57
65

ME 3810-288-35/2-1 ⑤

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 5 of 6)

KEY to fig. 2-1 ⑥

1. Stop
2. Strip
3. Hinge
4. Door
5. Jam
6. Cotter pin
7. Latch
8. Bolt (4)
9. Lock
10. Spacer
11. Key
12. Bolt (8)
13. Lockwasher (8)
14. Nut (8)
15. Bolt (8)
16. Lockwasher (12)
17. Jam
18. Bolt
19. Bolt (3)
20. Lockwasher (4)
21. Nut (4)
22. Jam
23. Strip
24. Strip
25. Panel
26. Guard
27. Guard
28. Cover
29. Cover
30. Screw (29)
31. Lockwasher (29)
32. Plate
33. Screw (5)
34. Washer (5)
35. Screw (6)
36. Washer (6)
37. Plate
38. Washer (6)
39. Screw (6)
40. Plate


1
2
3
4
5
6
7
8
9
10
11
6
9
8
7
22
23
24
25
26
27
28
29
41
20
21
20
18
19
17
14
13
16
15
12
15
16
30
31
36
39
35
38
36
34
35
33
40
37
32

ME 3810-294-20/2-43 ⑥

Figure 2-1. Cab sheet metal, removal and replacement (Sheet 6 of 6)

2-11. Cab Assembly

a. Removal.

(1) Unreeve boom hoist and load lines. Refer to TM 5-3810-294-10.

(2) Refer to figure 2-1 and remove sheet metal as required to remove the component.

b. Installation.

(1) Refer to figure 2-1 and install cab sheet metal removed during major component removal.

(2) Install front end attachment. Refer to TM 5-3810-294-10.

(3) Reeve the applicable lines, depending on which attachment is installed, as instructed in TM 5-3810-294-10.

2-12. Gantry Assembly

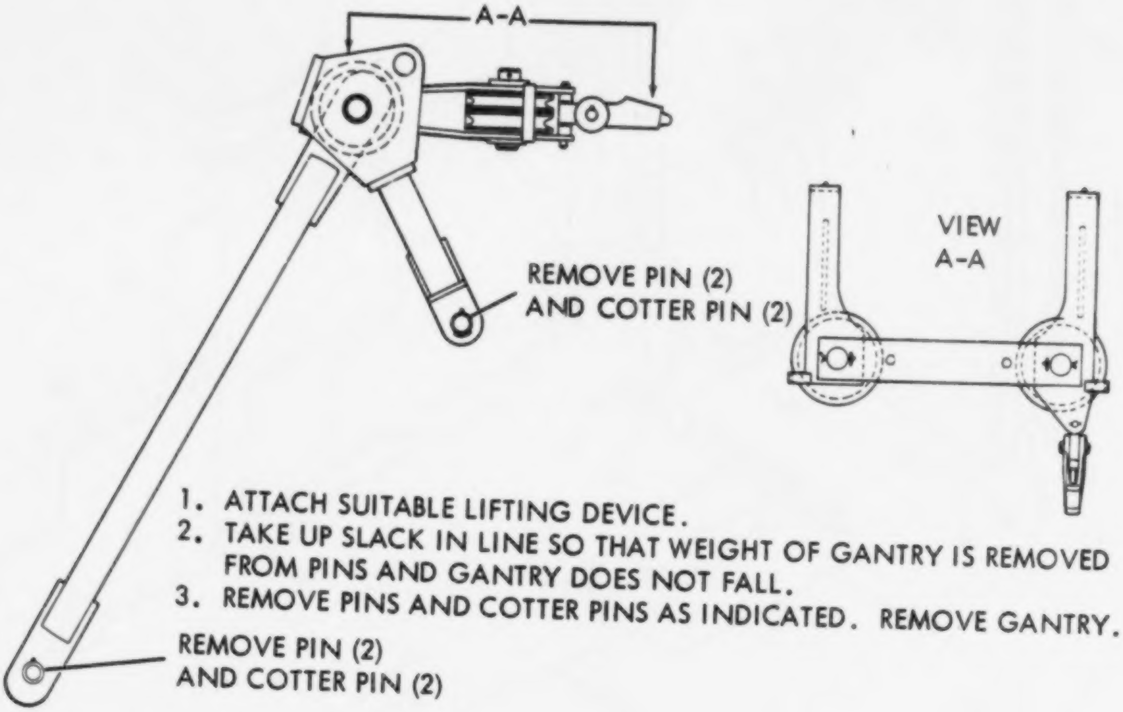
a. Removal.

(1) Remove front end attachment. Refer to TM 5-3810-294-10.

(2) Remove boom backstops. Refer to TM 5-3810-294-10.

(3) Refer to figure 2-1 and remove sheet metal as required.

(4) Refer to figure 2-2 and remove the gantry.



1. ATTACH SUITABLE LIFTING DEVICE.
2. TAKE UP SLACK IN LINE SO THAT WEIGHT OF GANTRY IS REMOVED FROM PINS AND GANTRY DOES NOT FALL.
3. REMOVE PINS AND COTTER PINS AS INDICATED. REMOVE GANTRY.

ME 3810-288-35/2-2

Figure 2-2. Gantry assembly, removal and installation.

b. Installation.

(1) Refer to figure 2-2 and install pins and cotter pins removed during gantry removal.

(2) Refer to figure 2-1 and replace sheet metal as required.

(3) Install boom or other front end attachment, install backstops, and install boom hoist and load lines (TM 5-3810-294-10).

2-13. Engine and Transmission Assembly

a. General. Because the engine and transmission assembly (fig. 2-3) is difficult to separate or remove except as a single assembly, it is removed and installed as a unit. The unit includes the radiator, engine, air cleaner, and transmission.

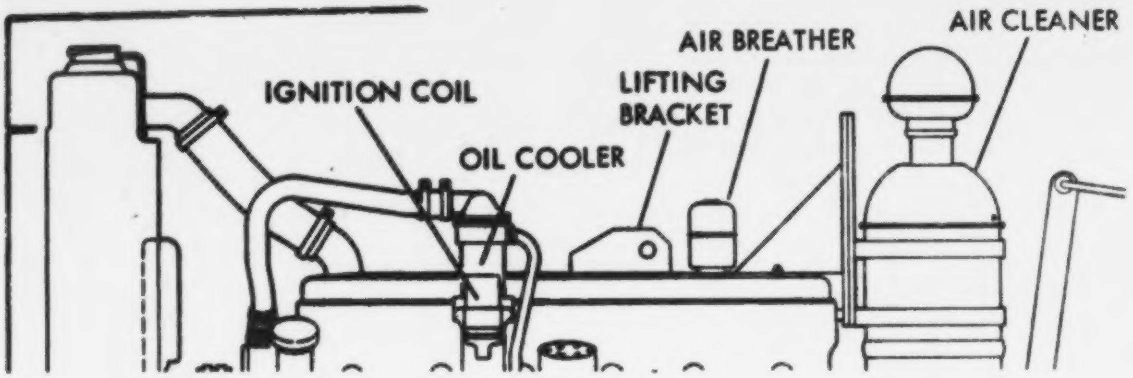


Figure 2-3. Engine and transmission assembly, removal and replacement.

b. Removal.

(1) Refer to TM 5-3810-294-20 and remove the muffler and engine exhaust standpipes.

(2) Refer to figure 2-1 ④ and remove items (25 through 32 and 42 through 50) from cover (73). Refer to TM 5-3810-294-20 and remove gantry. Remove cover (73).

(3) Remove rear panel (76), and rain shutter (93, fig. 2-1 ①). The engine is now accessible for removal.

(4) Refer to TM 5-3810-294-20 and attach a lifting device to the lifting bracket. No spreader bar or sling is required. Use a single chain of adequate strength.

(5) Disconnect electrical leads to the starter motor. Refer to TM 5-3810-294-20. Remove the leads to the reverse polarity relay. Tag all leads.

(6) Refer to figure 2-3 and disconnect linkage to the clutch lever.

(7) Disconnect the propeller shaft from the transmission, removing the four bolts which secure the shaft to the transmission output shaft flange.

(8) Refer to TM 5-3810-294-20 and disconnect the tachometer drive cable at the engine. Disconnect fuel connections to the engine at the fuel pump. Cap the fuel lines immediately. Disconnect wiring from the upper gage board to the engine at the terminal block identified in figure 2-3. See that all identification tags are on the leads before they are disconnected.

(9) Support the engine—radiator—air cleaner—transmission assembly using the chain and lifting device and remove the engine mount capscrews and lockwashers shown in figure 2-4.

(10) Remove the engine. It may be necessary for one man to guide the transmission end of the assembly as the engine is removed. Be careful not to allow the assembly to swing or to contact the sides of the cab.

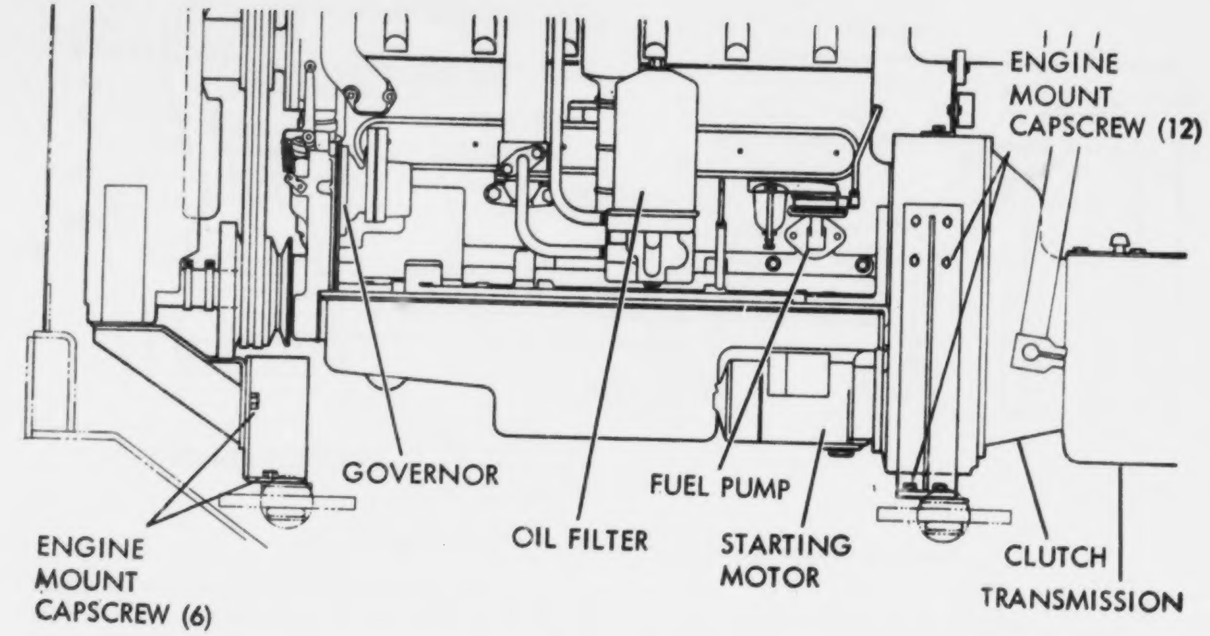


Figure 2-4. Engine mount capscrews, removal and replacement.

c. Installation.

(1) Refer to figure 2-3, attach a suitable lifting device and place the engine and transmission assembly on mounting brackets of the revolving frame. Refer to figure 2-4 and install mounting capscrews.

(2) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Connect tachometer drive cable at the engine. Connect fuel tubing to the engine at the fuel pump and intake manifold.

(b) Connect all electrical wiring disconnected during removal.

(c) Install propeller shaft.

(d) Install exhaust muffler and standpipe.

(3) Install gantry (fig. 2-2).

(4) Refer to figure 2-3 and connect the operator's clutch lever linkage to the clutch lever.

(5) Carefully inspect the engine. Make sure all hoses, pipes, tubes, and electrical connections are proper and secure. Service engine and transmission as instructed in TM 5-3810-294-20 before returning the machine to operation.

2-14. Transmission / Clutch Assembly

a. General. The transmission / clutch assembly is removed from the crane as a unit, along with the engine. The following procedures are for removing the transmission and clutch from the engine, after the engine has been removed.

b. Removal.

(1) Place the engine and transmission / clutch assembly on a suitable stand as shown in figure 2-5.

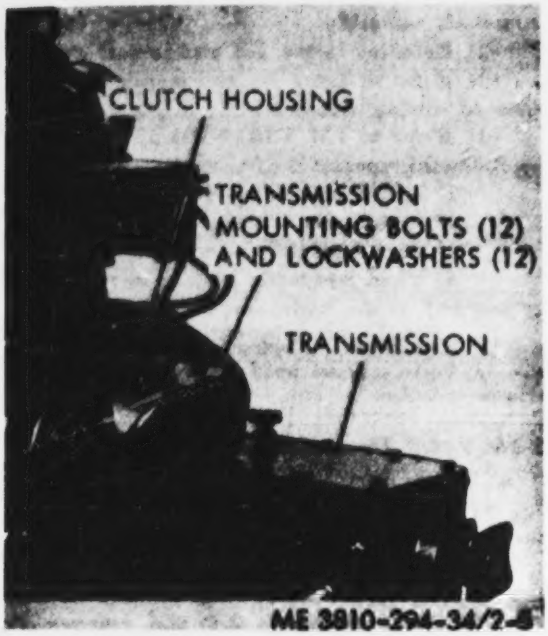

CLUTCH HOUSING
TRANSMISSION MOUNTING BOLTS (12) AND LOCKWASHERS (12)
TRANSMISSION
ME 3810-294-34/2-5

Figure 2-5. Transmission / clutch assembly, removal and replacement.

(2) Refer to figure 2-5 and remove the transmission assembly. The clutch housing and clutch must be removed with the transmission.

c. Installation.

(1) With the engine supported on a suitable stand, as shown in figure 2-5, preassemble the clutch in the flywheel ring gear making sure the driving plates and driven plates are properly centered in relation to the transmission input shaft and to each other. Then push the throwout bearing in to hold the clutch plates in the centered position.

(2) Aline the transmission input shaft with the clutch and with the clutch pilot bearing and slide the input shaft into the bearing through the clutch. Be sure the throwout yoke engages the buttons provided on the clutch throwout collar. Then refer to figure 2-5 and install the transmission / clutch assembly as a unit.

(3) Service the clutch and transmission as instructed in TM 5-3810-294-20.

2-15. Rear Drumshaft Assembly

a. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Close hydraulic reservoir shut-off valve.

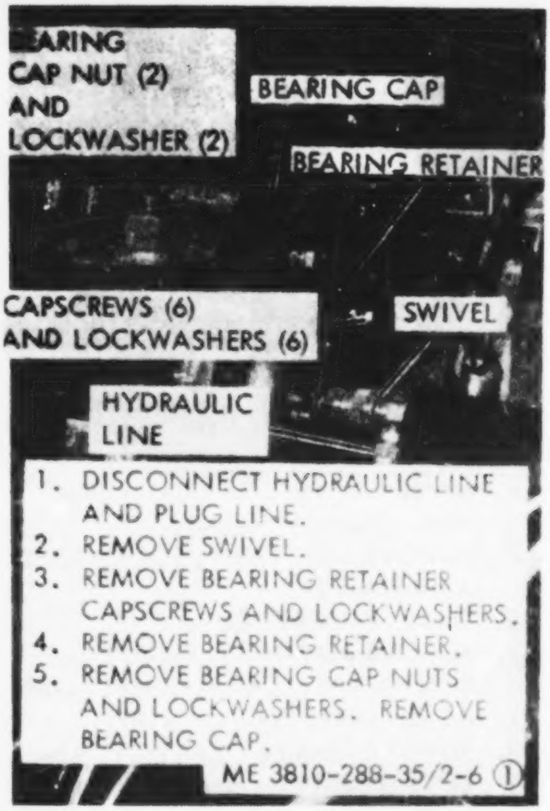
(b) Remove rear drumshaft drive chain case.

(c) Remove rear drum brake band.

(2) Refer to figure 2-1 and remove sheet metal as required to remove rear drumshaft through roof of the cab.

(3) Refer to figure 2-2 and remove gantry.

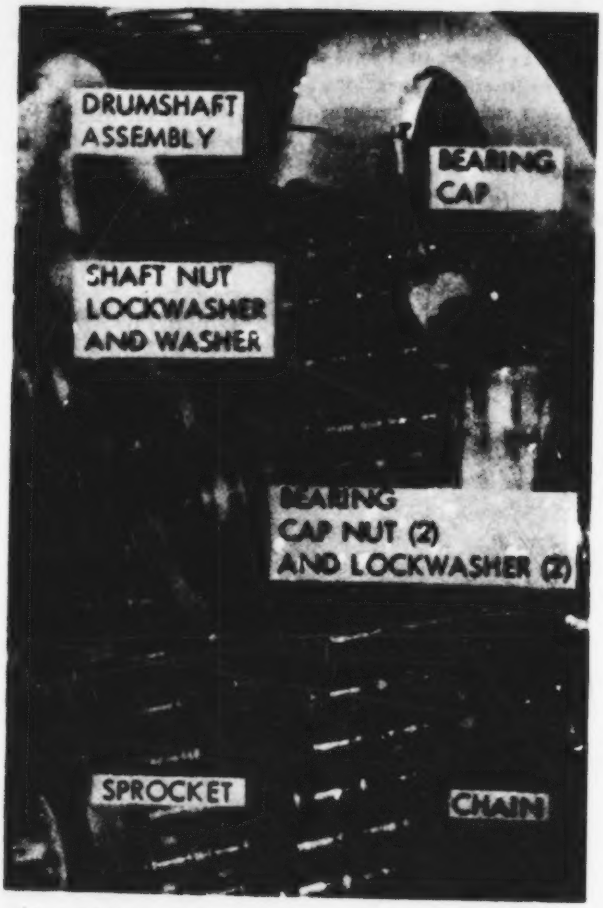
(4) Refer to figure 2-6 and remove rear drumshaft assembly.


EARING CAP NUT (2) AND LOCKWASHER (2)
BEARING CAP
BEARING RETAINER
CAPSCREWS (6) AND LOCKWASHERS (6)
SWIVEL
HYDRAULIC LINE

1. DISCONNECT HYDRAULIC LINE AND PLUG LINE.
2. REMOVE SWIVEL.
3. REMOVE BEARING RETAINER CAPSCREWS AND LOCKWASHERS.
4. REMOVE BEARING RETAINER.
5. REMOVE BEARING CAP NUTS AND LOCKWASHERS. REMOVE BEARING CAP.

ME 3810-288-35/2-6 ①

Figure 2-6. Rear drumshaft assembly, removal and installation (sheet 1 of 2).


DRUMSHAFT ASSEMBLY
BEARING CAP
SHAFT NUT LOCKWASHER AND WASHER
BEARING CAP NUT (2) AND LOCKWASHER (2)
SPROCKET
CHAIN

6. DRIVE OUT MASTER CHAIN LINK PINS. REMOVE CHAIN.
7. REMOVE SHAFT NUT, LOCKWASHER, AND WASHER.
8. SLIDE SPROCKET OFF.
9. REMOVE BEARING RETAINER CAPSCREWS AND LOCKWASHERS (SAME AS OPPOSITE END OF SHAFT).
10. REMOVE BEARING CAP NUTS AND LOCKWASHERS. REMOVE BEARING CAP.
11. ATTACH SUITABLE LIFTING DEVICE. REMOVE DRUMSHAFT ASSEMBLY.

ME 3810-288-35/2-6 ②

Figure 2-6. Rear drumshaft assembly, removal and installation (Sheet 2 of 2).

b. Installation.

(1) Refer to figure 2-6 and install rear drumshaft assembly.

(2) Refer to figure 2-2 and install gantry.

(3) Refer to figure 2-1 and install sheet metal removed during disassembly.

(4) Refer to TM 5-3810-294-20 and perform the following operations:

(*a*) Install rear drum brake band.

(*b*) Install rear drumshaft drive chain case.

(*c*) Open hydraulic reservoir shut-off valve.

(*d*) Bleed hydraulic system to remove any air trapped in the hydraulic lines.

***Note.* Be sure no hydraulic fluid comes into contact with any brake or clutch band while performing any maintenance operation.**

2-16. Front Drumshaft Assembly

a. Removal.

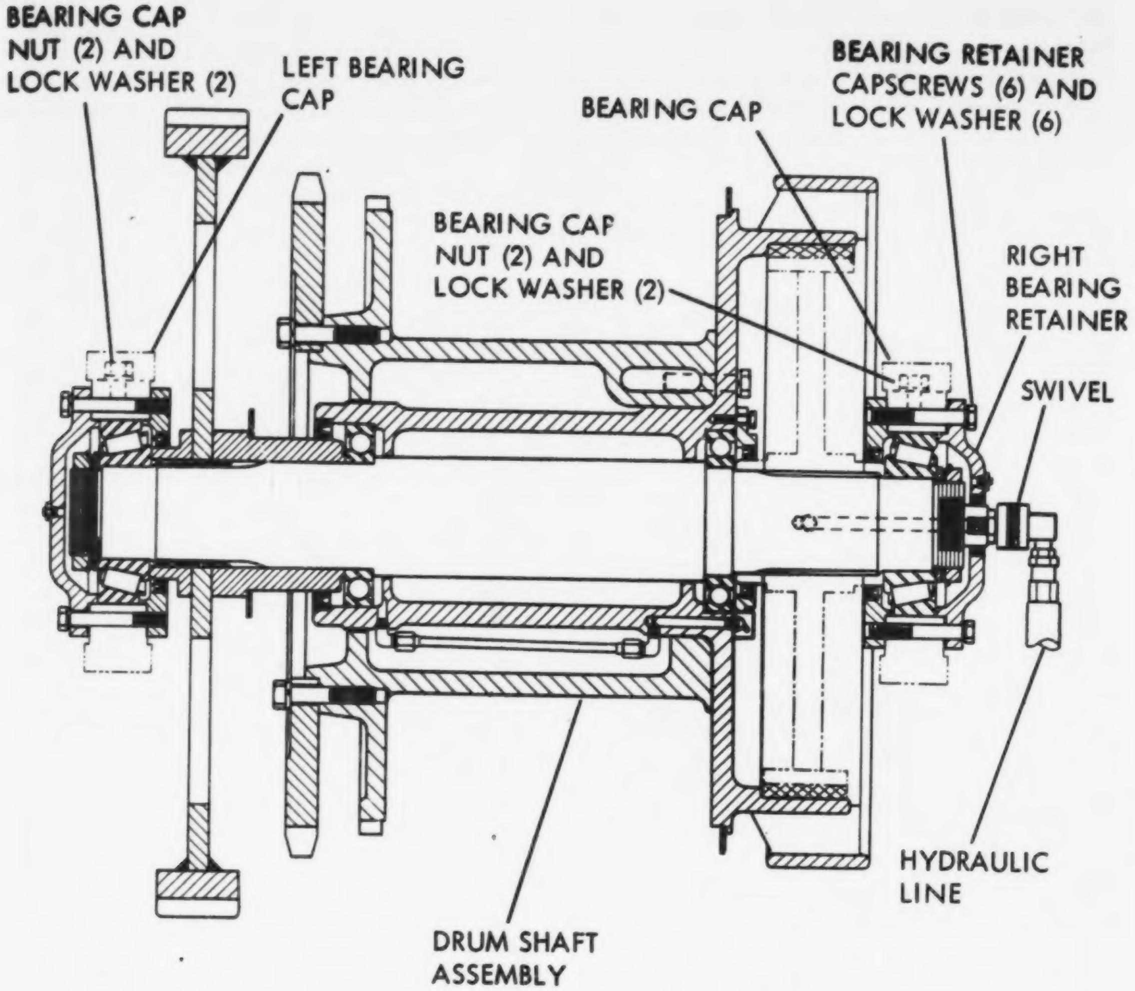
(1) Refer to TM 5-3810-294-20 and perform the following operations:

(*a*) Close hydraulic reservoir shut-off valve.

(*b*) Remove front drum brake band.

(2) Refer to figure 2-1 and remove sheet metal, as required, to allow removal of front drumshaft from the cab.

(3) Refer to figure 2-7 and remove front drumshaft assembly.


BEARING CAP NUT (2) AND LOCK WASHER (2)
LEFT BEARING CAP
BEARING CAP
BEARING RETAINER CAPSCREWS (6) AND LOCK WASHER (6)
BEARING CAP NUT (2) AND LOCK WASHER (2)
RIGHT BEARING RETAINER
SWIVEL
HYDRAULIC LINE
DRUM SHAFT ASSEMBLY

1. DISCONNECT HYDRAULIC LINE AND PLUG LINE.
2. REMOVE SWIVEL.
3. REMOVE BEARING RETAINER CAPSCREWS AND LOCK WASHERS ON SWIVEL END. REMOVE RIGHT BEARING RETAINER.
4. REMOVE BEARING CAP NUTS AND LOCK WASHERS ON RIGHT SIDE. REMOVE BEARING CAP.
5. REMOVE BEARING RETAINER CAPSCREWS AND LOCK WASHERS ON LEFT END. REMOVE LEFT BEARING RETAINER.
6. REMOVE BEARING CAP NUTS AND LOCK WASHERS ON LEFT END. REMOVE BEARING CAP.
7. REMOVE DRUM SHAFT ASSEMBLY.

ME 3810-288-35/2-7

Figure 2-7. Front drumshaft assembly, removal and installation.

b. Installation.

(1) Refer to figure 2-7 and install front drumshaft assembly.

(2) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Install front drum brake band.

(b) Open hydraulic reservoir shut-off valve.

(c) Bleed hydraulic line to the front drum assembly.

Note. Be sure no hydraulic fluid comes into contact with any brake or clutch band while performing any maintenance operation.

2-17. Reversing Shaft Assembly

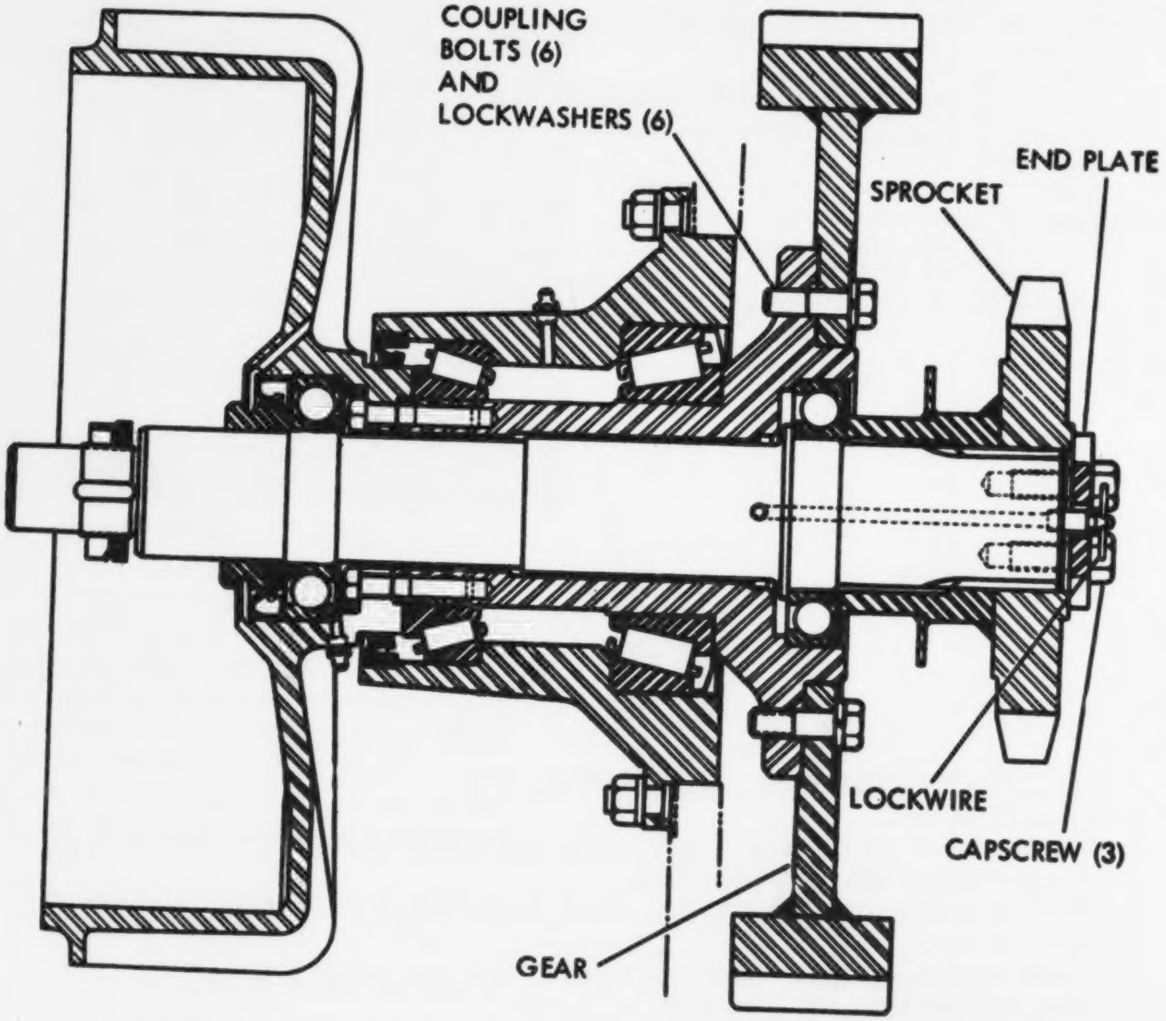
a. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Close hydraulic reservoir shut-off valve

*(b)*Remove reversing shaft chain tension by means of the reversing shaft chain tension adjusting idler. Lift chain from sprocket (fig. 2-8).

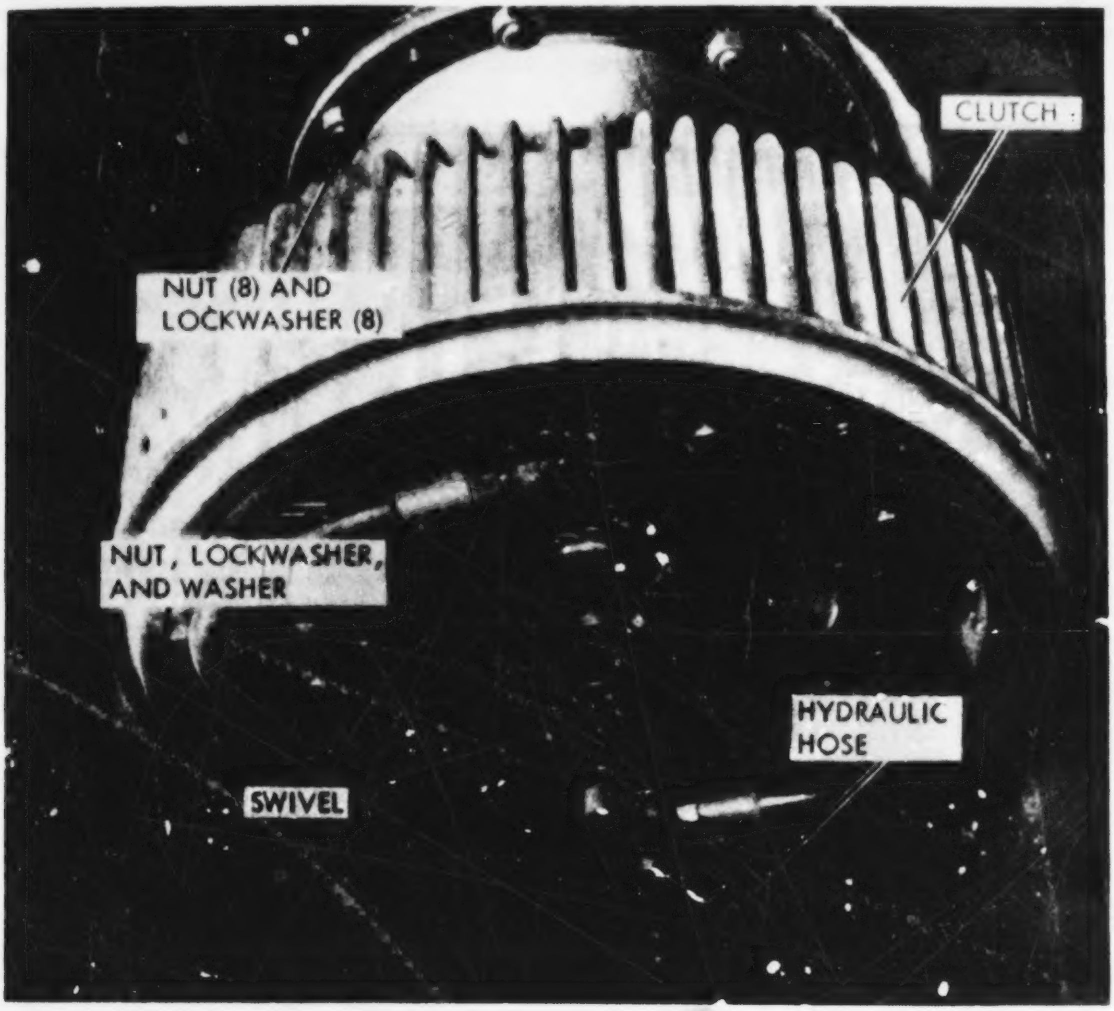
(c) Refer to figure 2-8 and remove the reversing shaft assembly.



1. BREAK LOCKWIRE AND REMOVE END PLATE BY REMOVING ATTACHING CAPSCREWS.
2. REMOVE SPROCKET.
3. REMOVE GEAR BY REMOVING ATTACHING COUPLING BOLTS.

ME 3810-288-35/2-8 ①

Figure 2-8. Reversing shaft assembly, removal and installation (Sheet 1 of 2).



4. DISCONNECT HYDRAULIC HOSE AT SWIVEL. PLUG HOSE AND SHAFT HOLE.
5. REMOVE SWIVEL.
6. REMOVE NUT, LOCKWASHER, AND WASHER.
7. REMOVE CLUTCH AS A UNIT.
8. SUPPORT ASSEMBLY USING A SUITABLE LIFTING DEVICE. REMOVE NUTS AND LOCKWASHERS. REMOVE REVERSING SHAFT.

ME 3810-288-35/2-8 ②

Figure 2-8. Reversing shaft assembly, removal and installation (sheet 2 of 2).

b. Installation.

(1) Refer to figure 2-8 and install reversing shaft.

(2) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Install reversing shaft chain and adjust chain tension.

(b) Open hydraulic reservoir shut-off valve.

(c) Bleed hydraulic line to the reversing shaft.

2-18. Horizontal Swing Shafts

a. General. Two horizontal swing shafts are used in this machine. Each shaft drives the upper in one direction only. The left shaft drives the upper to the right. The right shaft drives the upper to the left. Be sure the correct shaft is removed in the event of swing system malfunction.

b. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

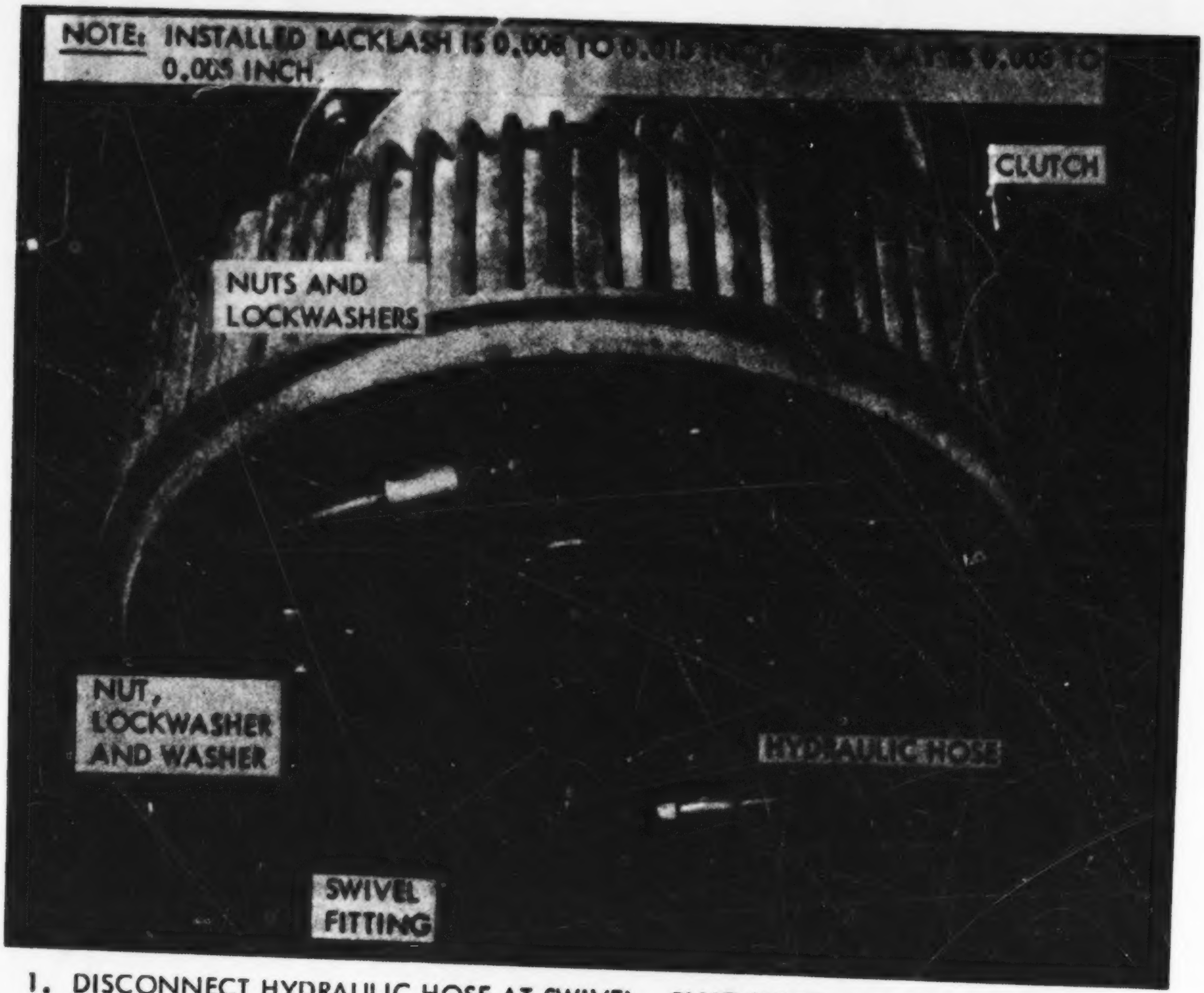
(a) Close hydraulic reservoir shut-off valve.

(b) Loosen horizontal swing shaft drive chain tension.

(c) Remove cover plate which allows access

to the horizontal swing shaft drive chains and lift the chain off the swing drive sprocket.

(2) Refer to figure 2-9 and remove horizontal swing shafts. Note that the removal procedure for both the left and right shafts is identical.



NOTE: INSTALLED BACKLASH IS 0.006 TO 0.01[illegible] IS 0.003 TO 0.005 INCH.

CLUTCH
NUTS AND LOCKWASHERS
NUT, LOCKWASHER AND WASHER
HYDRAULIC HOSE
SWIVEL FITTING

1. DISCONNECT HYDRAULIC HOSE AT SWIVEL. PLUG HOSE AND SHAFT HOLE IMMEDIATELY.
2. REMOVE SWIVEL.
3. REMOVE NUT, LOCKWASHER, AND WASHER.
4. REMOVE CLUTCH AS A UNIT.
5. SUPPORT ASSEMBLY WITH SUITABLE LIFTING DEVICE. REMOVE NUTS AND LOCKWASHERS.
6. REMOVE HORIZONTAL SWING SHAFT ASSEMBLY.

ME 3810-288-35/2-9

Figure 2-9. Horizontal swing shafts (left and right), removal and installation.

c. Installation.

(1) Refer to figure 2-9 and install the horizontal swing shaft using a suitable sling to hold the assembly.

(2) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Install cover plate which allows access to the horizontal swing shaft drive chains after placing the chain on the swing shaft sprocket and adjusting chain tension.

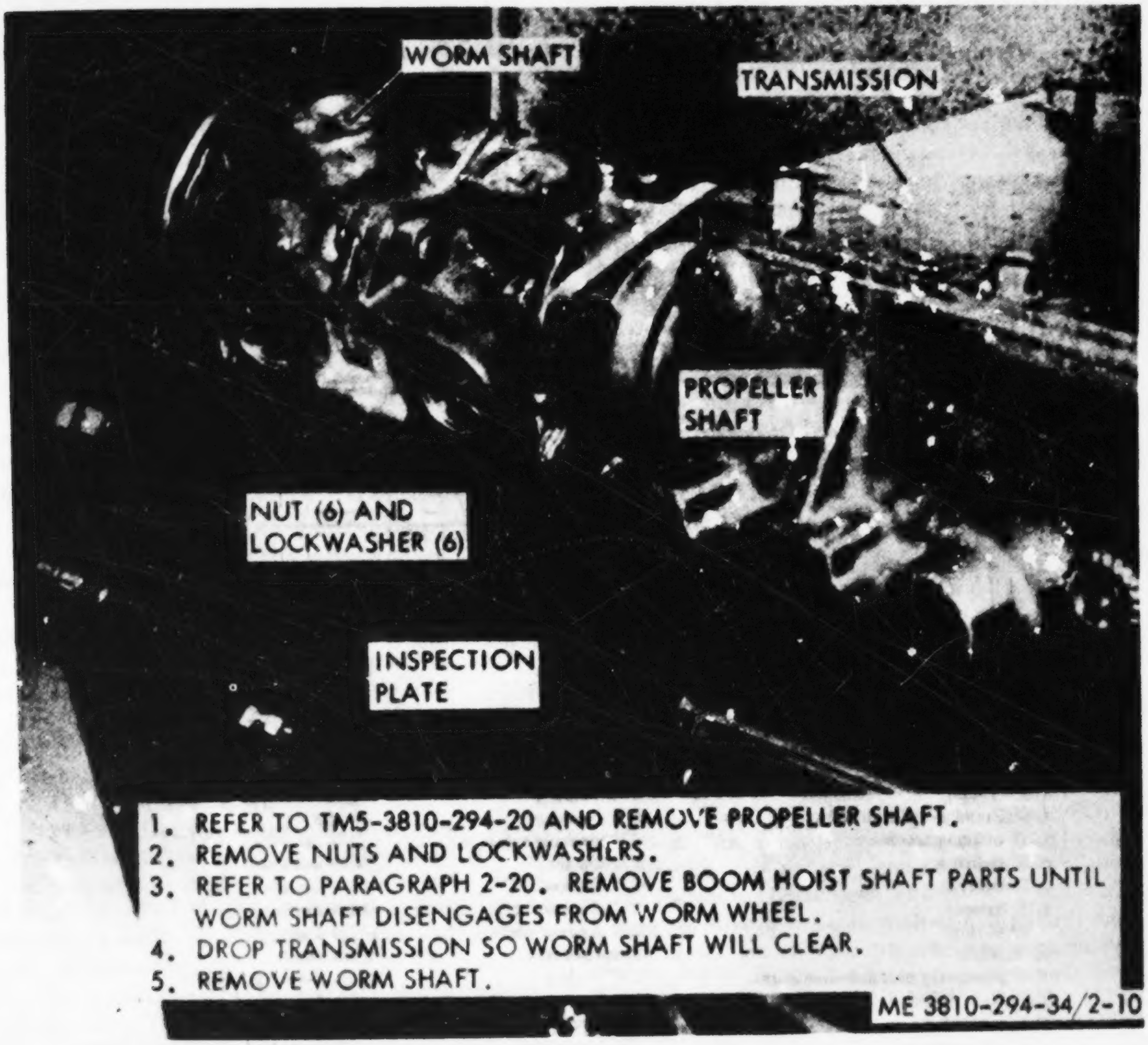
(b) Open hydraulic reservoir shut-off valve.

(c) Bleed hydraulic line to the swing shaft clutch.

(d) Adjust clutch.

2-19. Worm Shaft Assembly

a. Removal. Refer to figure 2-10 and remove the worm shaft assembly.



1. REFER TO TM5-3810-294-20 AND REMOVE PROPELLER SHAFT.
2. REMOVE NUTS AND LOCKWASHERS.
3. REFER TO PARAGRAPH 2-20. REMOVE BOOM HOIST SHAFT PARTS UNTIL WORM SHAFT DISENGAGES FROM WORM WHEEL.
4. DROP TRANSMISSION SO WORM SHAFT WILL CLEAR.
5. REMOVE WORM SHAFT.

ME 3810-294-34/2-10

Figure 2-10. Worm shaft assembly, removal and installation.

*b. **Installation.*** Refer to figure 2-10 and install the worm shaft assembly. Check worm shaft end play, (between 0.003 and 0.005 inch) using a dial indicator. If end play is not within these limits, add or subtract shims (40, 41, 42, fig. 2-11) until correct end play is obtained.

2-20. Boom Hoist Shaft

a. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Lower attachment to the ground.

(b) Remove boom hoist clutch.

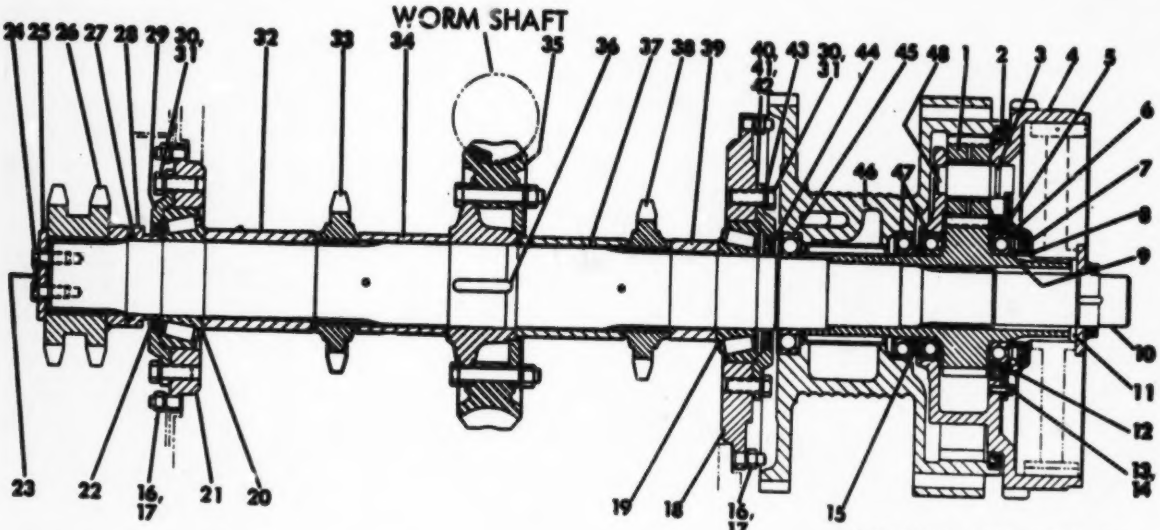
(c) Remove boom hoist brake.

(d) Remove rear drum chain case and remove the rear drum drive chain.

(e) Remove cover which provides access to the horizontal swing shaft drive chain. Loosen the drive chain. Remove chains from the horizontal swing shaft sprockets, but do not break the chains at the master links.

(2) After the above has been done, the boom hoist shaft will be as shown in figure 2-11. Refer to figure 2-11 and disassemble the boom hoist shaft as follows:

Note. It is necessary to disassemble the shaft to remove it. It cannot be removed as an assembly.



ME 3810-288-35/2-11

1. Planetary pinion with bushing
2. Oil seal
3. O -ring
4. Planetary clutch drum
5. Bearing retainer
6. Bearing
7. Oil seal
8. Spacer
9. O-ring
10. Shaft
11. Planetary clutch hub and gear
12. Grease fitting
13. Capscrew
14. Lockwasher
15. Spacer
16. Lockwasher
17. Hex nut
18. Bearing retainer
19. Bearing
20. Bearing
21. Bearing retainer
22. Oil seal
23. Lockwire
24. Capscrew (2)
25. Keeper plate
26. Sprocket
27. O-ring
28. Spacer
29. Bearing retainer
30. Capscrew
31. Lockwasher
32. Spacer
33. Sprocket
34. Spacer
35. Worm wheel assembly
36. Key
37. Spacer
38. Sprocket
39. Spacer
40. Shim
41. Shim
42. Shim
43. Bearing retainer
44. Oil seal
45. Bearing
46. Planetary boom hoist drum
47. Bearing
48. Pinion pin

Figure 2-11. Boom hoist shaft assembly, removal and replacement.

(a) Support boom hoist drum (46) with a suitable sling and slide it off shaft (10) as an assembly. Items (1) through (14) and (45, 47, 48) will come off the shaft with the drum.

(b) From the opposite end of the boom hoist shaft, remove lockwire (23), two capscrews (24), keeper plate (25), and sprocket (26). Remove O-ring (27) and spacer (28).

(c) Place suitable blocking beneath each end of the shaft to prevent the shaft from dropping when bearing retainers (29) and (43) are removed. Remove bearing retainers (29 and 43) by removing six capscrews and lockwashers (30 and 31) at each bearing retainer. Oil seals (22 and 44) will come out in the retainers.

(d) Remove eight nuts and lockwashers (17 and 16) at bearing retainers (21 and 18). Remove bearing retainers (21 and 18). Two tapped puller holes are provided in the bearing retainers to assist in removal.

(e) Remove inner races of bearings (20 and 19) from the shaft, using a suitable puller.

(f) Remove sufficient blocking from each end of the shaft to disengage the worm wheel (35) from the worm shaft. All remaining items on shaft (32 through 39) can then be removed by removing the shaft through the right side of the chain case. Strip items (32 through 39) off shaft (10). Do not disassemble worm wheel assembly (35).

b. Installation.

Note. Always replace both drive chains if one must be replaced.

(1) Refer to figure 2-10 and install the worm shaft if it has been removed. The worm shaft must be installed before the boom hoist shaft can be installed.

(2) Install key (36, fig. 2-11) and press worm sheet assembly (35) on shaft (10). The faces of wheel assembly (35) hub must be flush with the shaft (10) shoulder, as illustrated.

(3) Coat worm wheel teeth (35) with a light coating of white lead of Prussian blue. This will be used later to adjust the worm wheel-to-worm shaft gear contact. The finished face of the worm wheel must be placed on the right side, as viewed from the rear, of the shaft.

(4) Install spacers (34 and 37) and sprockets (33 and 38). The sprockets must be tight against the spacers.

Note. Sprockets (33 and 38) are match marked during manufacture and must be installed in matched pairs. Be sure both sprockets have the same number stamped on the outer face. See that the match marked internal spline on each sprocket mates properly with the marked splines on the shaft.

(5) Install spacers (32 and 39). Warm the inner races of bearings (20 and 19) and install the inner races on each end of the shaft. The races must be pressed firmly into place in one motion and must bear against spacers (32 and 39) to form one solid assembly.

(6) Install the subassembled shaft in the bore in the revolving frame and block it firmly in position with the shaft centered in the bore. Worm wheel (40) must be engaged in the worm shaft.

(7) Install the outer races of bearing (20 and 19) in bearing retainers (21 and 18). Install bearing retainers on shaft (10) and secure in position with eight nuts and lockwashers (17 and 16) on each bearing retainer.

(8) Subassemble oil seals (22 and 44) into retainers (29 and 43). Be sure the seals are installed with the springs facing sprockets (33 and 38) and that the areas between the seal lips are packed with GAA lubricant. Check seal seating surfaces of the shaft for nicks or burrs; minor imperfections on the shaft can cause rapid seal wear.

(9) Install shims (40, 41, and 42) in equal amounts between bearing retainers (29 and 43) and retainers (21 and 18) so that shaft end play is between 0.003 and 0.005 inch, using a dial indicator. Install the two bearing retainers (29 and 43) using six capscrews and lockwashers (30 and 31).

(10) Adjust worm wheel-worm shaft backlash as follows.

(a) Turn the worm shaft through one complete revolution.

(b) Check the points of contact between the worm and worm wheel (35) shown on the shaded area on worm wheel (35) in figure 2-11. Under no load conditions, all contact must be to the left of the center of the worm shaft. Note that the tooth contact must be checked by removing the inspection plate shown in figure 2-10 and that it must be inspected at the bottom of the worm wheel, since the top cannot be seen.

(c) If all contact is not on the left side of the worm shaft, move shims (40, 41, and 42) as required to a point beneath the opposite bearing retainer, until proper contact is established. Recheck boom hoist shaft end play.

(d) Use a suitable sealing compound, such as Permatex No. 2 on capscrews and lockwashers (30 and 31) and adjacent sealing surfaces.

(11) Subassemble the boom hoist drum (46) as follows.

(a) Position drum (46) on the workbench with the ratchet side up. Pack drum with grease, type GAA, as described in the current LO.

(b) Tap bearing (45) into the drum until it is firmly seated against the drum shoulder. Turn drum over and finish packing drum cavity with grease. Install bearing (47) in this end of drum. Place spacer (15) on top of bearing (47) as shown.

(c) Install oil seal (2) in drum (46). Pack seal with type GAA grease and be sure the sealing lip points inward as shown in figure 2-11.

(d) Position drum (4) on drum (46). Install pinions (1) in drum (4).

(e) Lubricate O-rings (3) and install them on pinion pins (48). Install pins (48) in pinions (1). Turn the pins so that the flats on the outer ends of the pins allow bearing retainer (5) to be installed. Install oil seal (7) in bearing retainer (5). Be sure the sealing lip points inward, and pack the seal with type GAA grease as described in the current LO.

(f) Warm and install bearing (47) on the elongated hub of hub and gear (11). Warm and install bearing (6) on the opposite end of hub and gear (11). Install O-ring (9) on hub and gear (11).

(g) Install hub and gear (11) with bearings (47 and 6), and O-ring (9) into drum (46) as an assembly.

(h) Install retainer (5) with grease fitting (12) in place in the retainer, and secure retainer with six capscrews and lockwashers (13 and 14).

(i) Carefully slide spacer (8) into position against bearing (6).

(j) Using a suitable hoist, lift the assembled drum and install it as an assembly on the right end of shaft (10, fig. 2-11).

(12) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Install boom hoist brake band and adjust as instructed.

(b) Install boom hoist clutch and adjust as instructed.

(c) Open hydraulic reservoir shut-off valve.

(d) Bleed hydraulic lines to the boom hoist clutch and boom hoist brake.

(e) Install rear drum chain case and the rear drum drive chain and adjust chain tension as instructed.

(f) Adjust horizontal swing shaft chain tension; be sure chains are properly mounted on all sprockets before tightening eccentric adjusting shafts. Reinstall the cover which provides access to the chains.

Note. Be sure to prevent hydraulic fluid from coming into contact with brake clutch linings during any repair procedure.

2-21. Vertical Swing Shaft

a. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Remove front end attachment.

(b) Remove hook rollers.

(c) Drain main upper gear case oil.

(d) Remove one horizontal swing shaft, either left or right.

(2) Using a suitable overhead crane or other lifting device, attach a lifting sling to the boom foot lugs on the revolving frame and to the gantry peak pin. Remove the upper from the carrier and place it on suitable blocking, at least 3 feet above the ground to provide adequate working room beneath the revolving frame.

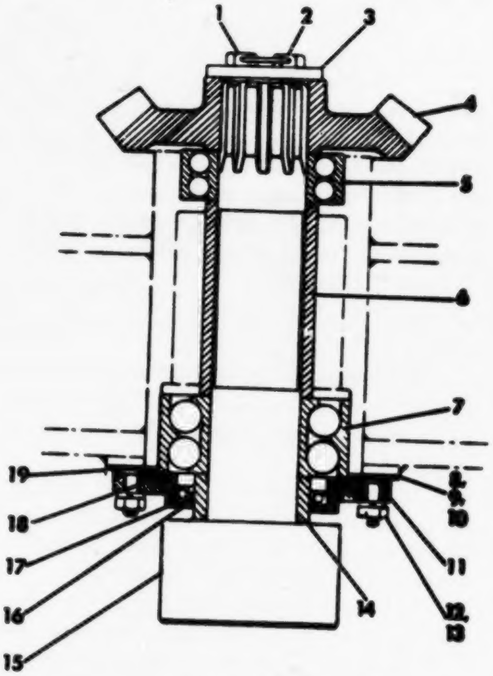
(3) Refer to figure 2-12 and remove the vertical swing shaft as follows:

(a) Block shaft from below so that it cannot fall.

(b) Remove six nuts (12) and six lockwashers (13) and remove retainer (11).

(c) From above, break lockwire (2) and remove two capscrews (1) and washer (3).

(d) Carefully remove blocking from beneath the shaft and remove shaft through bottom of the revolving frame. If may be necessary to bump the shaft from above to start it out of gear (4).



ME 3810-288-35/2-12

1. Capscrew
2. Lockwire
3. Washer
4. Gear
5. Bearing
6. Spacer
7. Bearing
8. Shim
9. Shim
10. Shim
11. Retainer
12. Nut
13. Lockwasher
14. Spacer
15. Pinion shaft
16. Oilseal
17. Bearing retainer
18. O-ring
19. Gasket

Figure 2-12. Vertical swing shaft, removal and installation.

b. Installation.

(1) Refer to figure 2-12 and install the shaft as follows:

(a) Install bearing (5).

(b) Install a new oil seal (16) in retainer (17). Inspect seating surface of spacer (14) to be sure the seal is not damaged by contact with a rough surface.

(c) Install spacer (14) and retainer (17) with oil seal (16) on pinion shaft (15).

(d) Warm and install bearing (7) on pinion shaft (15). Be sure the inner race is seated firmly against spacer (14).

(e) Place spacer (6) on pinion shaft (15) and insert entire assembly through the bottom of the bore in the revolving frame. Block the pinion shaft so that it cannot drop out.

(f) Working through the access opening in the revolving frame top, install bearing (5), gear (4), washer (3), and capscrews (1). Do not lockwire the capscrews at this time.

(g) Install a new O-ring (18) in retainer (11). Install shim (8, 9, and 10) and gasket (19). Install retainer (11) with O-ring (18) in place in the retainer and secure in position with six nuts (12) and lockwashers (13).

(2) With the vertical swing shaft installed as instructed above, check the backlash and tooth contact between the horizontal swing shaft gears and the vertical swing shaft gear (4) as follows.

(a) Refer to figure 2-13 and check backlash between the gears as shown. Correct backlash is between 0.008 and 0.013 inch. If backlash is not within these limits, it will be necessary to add or remove shims (8, 9, or 10, fig. 2-12) to bring the backlash within these limits.

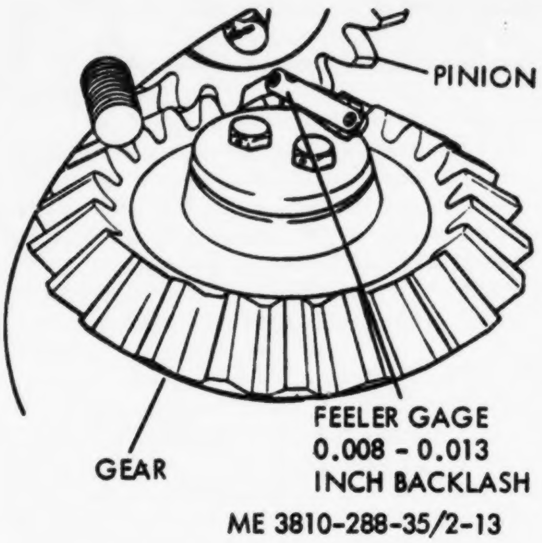
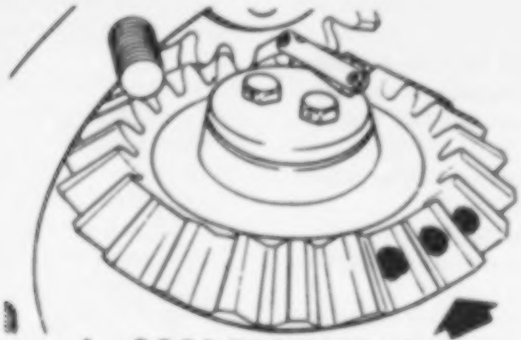
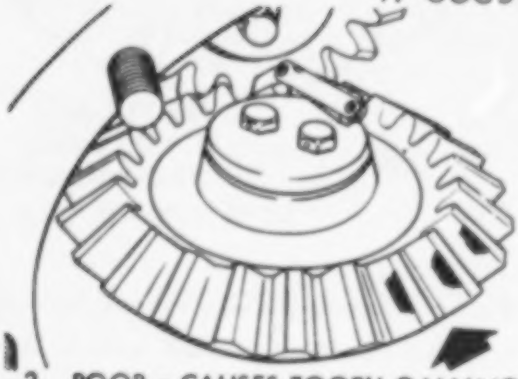


Figure 2-13. Checking vertical swing shaft bevel gear backlash.

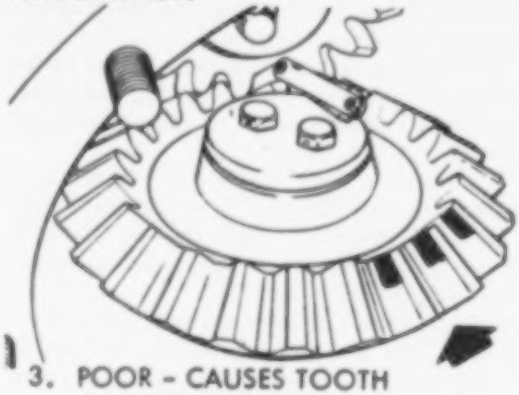
(b) If gear tooth contact is not in the approximate center of the vertical swing shaft gear (4, fig. 2-12) as illustrated in figure 2-14, it will be necessary to move the horizontal swing shaft in or out, as required, by removing or installing shims (18, 19, and 20, fig. 5-12).



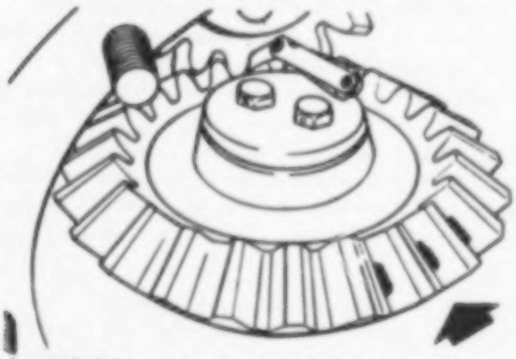
1. GOOD TOOTH CONTACT.



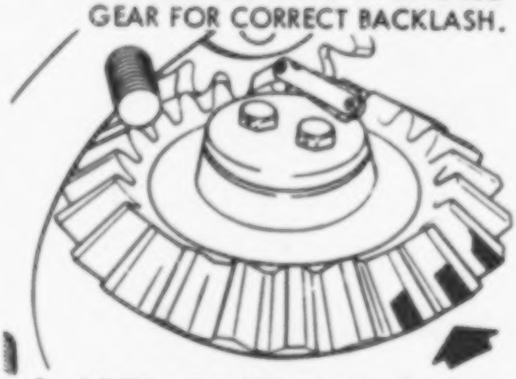
2. POOR - CAUSES TOOTH GALLING AND NOISY OPERATION. MOVE PINION TOWARD GEAR FOR CORRECT CONTACT AND LOWER GEAR FOR CORRECT BACKLASH.



3. POOR - CAUSES TOOTH GROOVING, GALLING AND NOISY OPERATION. MOVE PINION AWAY FROM GEAR FOR CORRECT CONTACT AND RAISE GEAR FOR CORRECT BACKLASH.



4. POOR - CAUSES CHIPPING AND EXCESSIVE WEAR. LOWER GEAR FOR FOR CORRECT CONTACT, MOVE PINION TOWARD GEAR FOR CORRECT BACKLASH.



5. POOR - CAUSES CHIPPING AND EXCESSIVE WEAR. RAISE GEAR FOR CORRECT CONTACT, MOVE PINION AWAY FROM GEAR FOR CORRECT BACKLASH.

ME 3810-288-35/2-14

Figure 2-14. Checking gear tooth contact.

(3) After the preceding adjustments have been completed, lockwire capscrews (1, fig. 2-12).

(4) Using a suitable overhead crane or other lifting device, attach a lifting sling to the boom foot lugs on the revolving frame and to the gantry peak pin. Install the revolving frame on the carrier. Keep the revolving frame stabilized; using the lifting sling, until the hook rollers are installed.

(5) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Install hook rollers.

(b) Adjust horizontal swing shaft drive chain tension.

(c) Lubricate upper, including adding oil to the gear case.

(d) Install front end attachment.

2-22. Swing Brake Shaft

a. Removal.

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Remove front end attachment.

(b) Remove hook rollers.

(c) Drain oil from upper gear case as shown in the lubrication chart.

(2) Using a suitable overhead crane or other lifting device, attach a lifting sling to the boom foot lugs on the revolving frame and to the gantry peak pin. Remove the upper from the carrier and place it on suitable blocking, at least 3 feet above the ground to provide adequate working room beneath the revolving frame.

Note. Removing the revolving frame is only necessary if the swing brake shaft itself is to be removed. The wearing components of the brake, with the exceptions of the brake shaft and shaft bearings (items 26 through 31, fig. 2-15) can be removed without undecking the machine.

(3) Refer to figure 2-15 and remove the swing brake shaft, as follows:

(a) Remove capscrews (1) and lockwashers (2). Remove shield (3), pipe spacers (48), retainer (47). Place blocking beneath shaft (26) so it cannot fall.

(b) Remove capscrews (4), lockwashers (5), and eye bolts (6).

(c) Remove nuts (38), spring seat (39), spring (40) and spring seat (41). Remove pins (7).

(d) Remove nuts (9) and spring bolt (16). Loosen nuts (17) so that rod (18) can be unscrewed from brake shoe bracket (8). Remove rod (18).

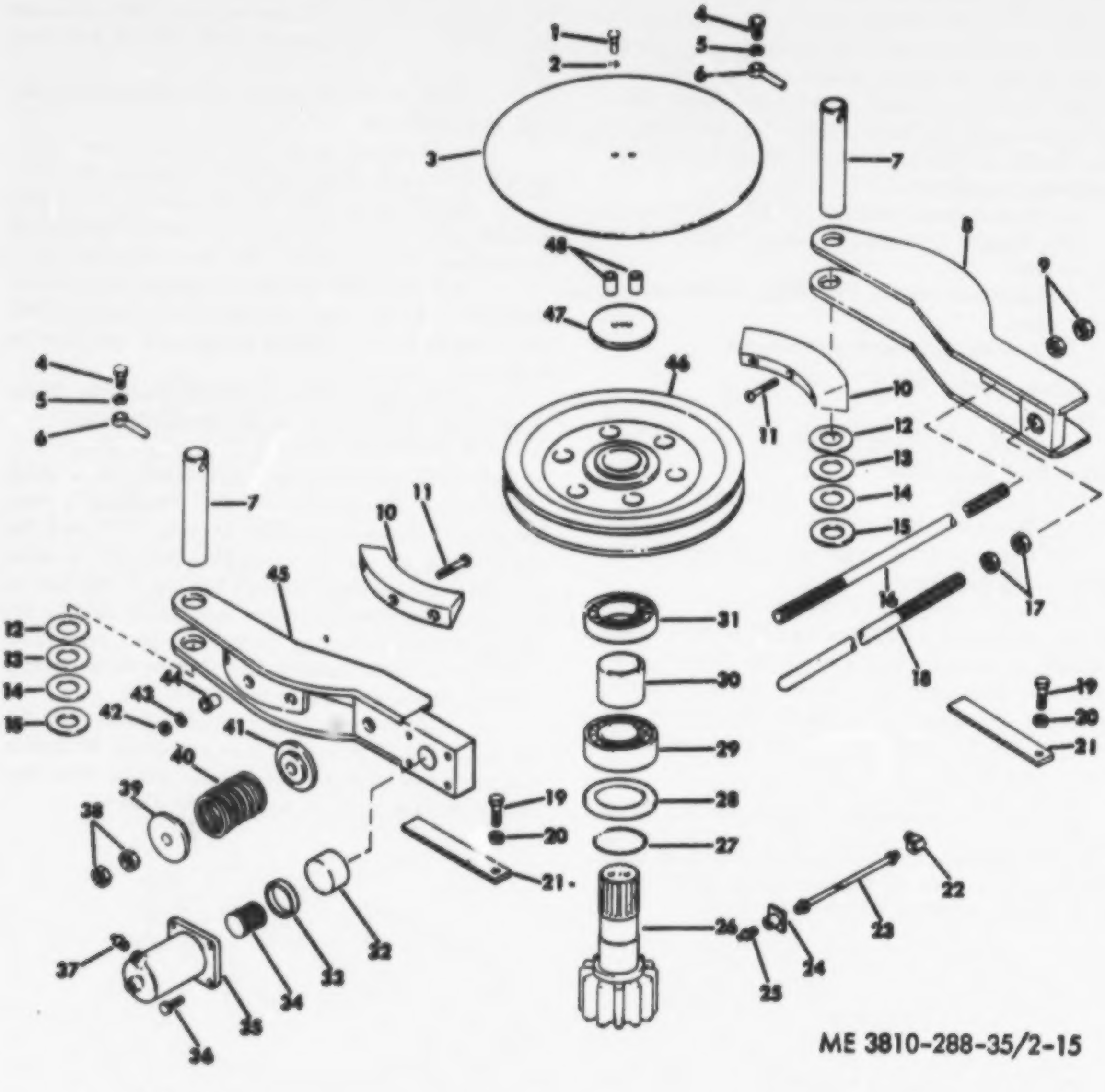
(e) Remove brake shoe brackets (45 and 8). Remove nuts (42), lockwashers (43), bushings (44) and capscrews (11). Brake linings (10) can now be removed.

(f) Remove shims (12, 13, and 14). Place shims and washers aside for reinstallation.

(g) Remove items (22 through 25).

(h) Remove brake sheave (46). Press shaft (26) out of the bottom of the revolving frame. Bearing (29), retainer (28), O -ring (27) and the shaft come off as an assembly. Remove bearing (31) and spacer (30) through the top of the bore in the revolving frame. Do not remove or change the adjustment of adjusting bolts (19), jam nuts (20), or brackets (21). The purpose of these three parts is to keep the brake shoes level.

(i) Remove capscrews (36). Items (32, 33, 34, 35, and 37) come off as an assembly. However, it is recommended that these items not be disturbed unless replacement of parts is necessary.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
ME 3810-288-35/2-15

1. Capscrew
2. Lockwasher
3. Shield
4. Capscrew
5. Lockwasher
6. Eye bolt
7. Pin
8. Brake shoe bracket
9. Nut
10. Brake lining
11. Capscrew
12. Shim
13. Shim
14. Shim
15. Washer
16. Spring bolt
17. Nut
18. Release rod
19. Adjusting bolt
20. Jam nut
21. Bracket
22. Male elbow
23. Tube assembly
24. Bracket
25. Grease fitting
26. Brake shaft
27. O -ring
28. Retainer
29. Bearing
30. Spacer
31. Bearing
32. Piston
33. Retainer
34. Spring
35. Cylinder
36. Capscrew
37. Bleeder fitting
38. Nut
39. Spring seat
40. Spring
41. Spring seat
42. Nut
43. Lockwasher
44. Bushing
45. Brake shoe bracket
46. Brake sheave
47. Retainer
48. Pipe spacer

Figure 2-15. Swing brake shaft, removal, disassembly, and replacement.

b. Installation.

(1) Refer to figure 2-15 and install O -ring (27) in retainer (28) and place the two items on shaft (26) with the O -ring down.

(2) Install bearing (29) on shaft (26). Make sure the bearing fits firmly against retainer (28). Place spacer (30) on the shaft, above bearing (29).

(3) Subassemble items (11, 16, 42, 43, and 44) into brake shoe bracket (45). Subassemble the same items into brake shoe bracket (8).

(4) Install items (32, 33, 34, 35, and 37) on brake shoe bracket (45) and secure in position with capscrews (36). Screw release rod (18) with nuts (17) in place into bracket (8), which is tapped to receive the threaded end of the rod.

(5) Place bolt (16) in bracket (8) and install nuts (9). Place brake shoe bracket (45) over opposite end of bolt (16) and install spring seat (41), spring (40), spring seat (39), and nuts (38).

(6) Install the subassembled shaft (26) into the bore of the revolving frame from beneath the frame. Install bearing (31) from above the frame. Install sheave and secure it in place with retainer (47), spacers (48), shield (3), and capscrews and lockwashers (1 and 2).

(7) Place the two subassembled brake shoe brackets (45 and 8) on sheave (46).

(8) Install washers (15) and shims (12, 13, and 14) and secure them in position with pins (7). Install items (4, 5, and 6).

(9) Install items (22 through 25).

(10) Using a suitable overhead crane or other lifting device, attach lifting sling to the boom foot lugs on the revolving frame and to the gantry peak pin. Install the revolving frame on the carrier. Keep the revolving frame stabilized, using the lifting sling, until the hook rollers are installed.

(11) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Reinstall hook rollers.

(b) Adjust swing brake.

(c) Bleed hydraulic lines.

(d) Lubricate swing brake shaft.

(e) Reinstall front end attachment, if required.

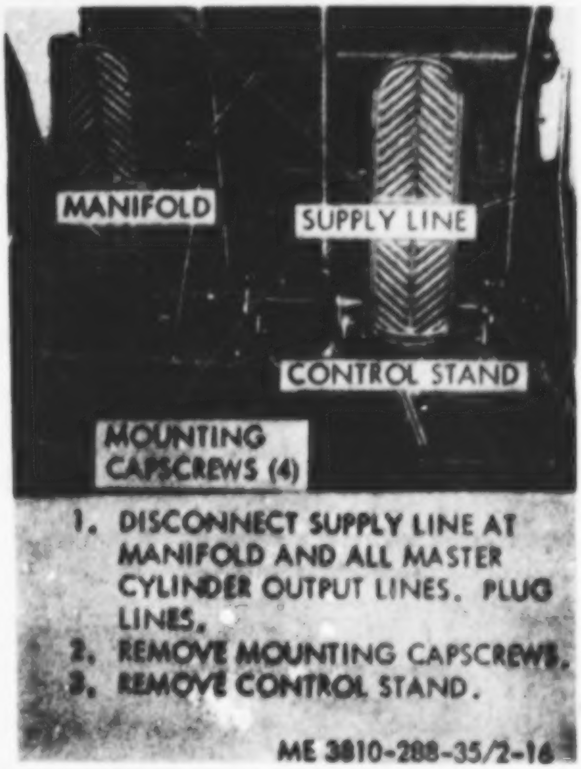
2-28. Control Stand Assembly

a. Removal.

(1) Refer to TM 5-3810-294-20 and shut off the hydraulic oil supply to the control stand assembly illustrated in figure 2-16.

(2) Refer to figure 2-1 and remove plates and floor plates as required to expose the control stand assembly, as illustrated in figure 2-16.

(3) Refer to figure 2-16, remove the control stand assembly.



1. DISCONNECT SUPPLY LINE AT MANIFOLD AND ALL MASTER CYLINDER OUTPUT LINES. PLUG LINES.
2. REMOVE MOUNTING CAPSCREWS.
3. REMOVE CONTROL STAND.

ME 3810-288-35/2-16

Figure 2-16. Control stand assembly, removal and installation.

b. Installation.

(1) Refer to figure 2-16 and install the control stand assembly.

(2) Refer to TM 5-3810-294-20, open the hydraulic reservoir shut-off valve, replenish hydraulic oil in the reservoir, if necessary, and bleed the air from the control stand assembly.

(3) Refer to figure 2-1 and reinstall deck plates and sheet metal as required.

CHAPTER 3

REPAIR OF CRANE ENGINE ACCESSORIES

Section I. REPAIR OF ALTERNATOR

3-1. Description

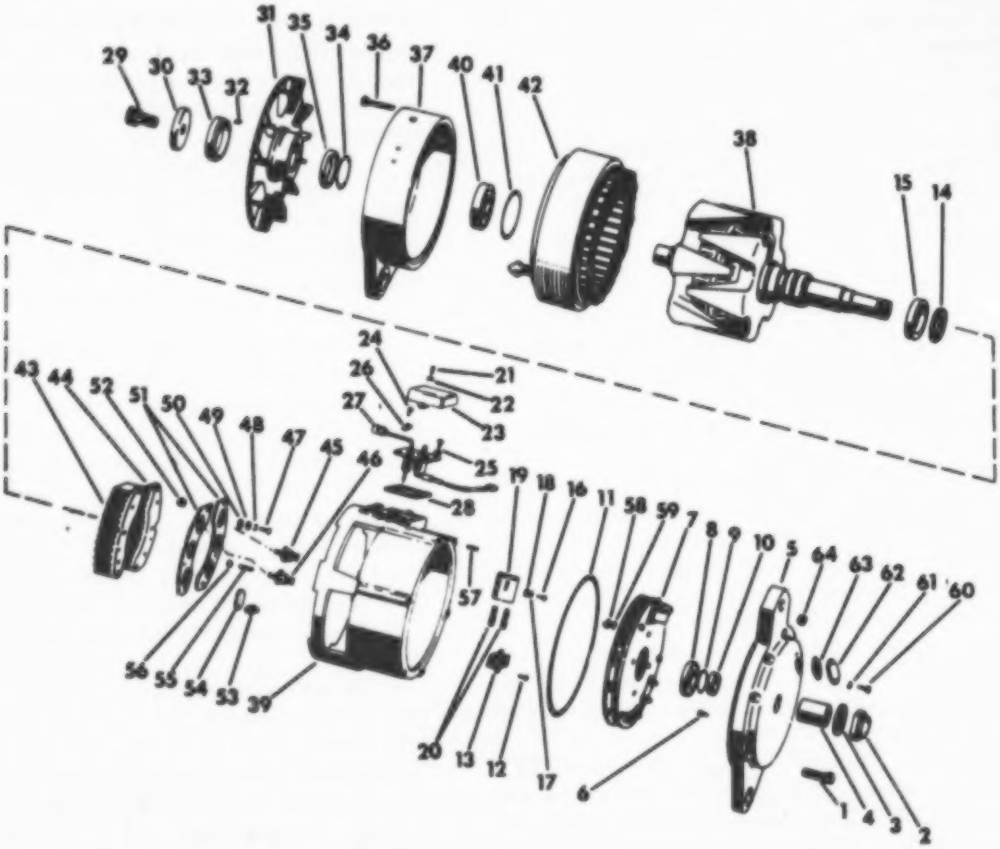
The alternator is a twin belt driven, 24 volt 60 ampere type with solid state internally mounted rectifiers.

3-2. Removal

Refer to TM 5-3810-294-20 to disconnect and remove the alternator from the engine.

3-3. Disassembly

Refer to figure 3-1 and disassemble the alternator as follows:


31
35
34
36
37
29
30
33
32
40
41
42
38
15
14
24
26
21
22
27
23
25
43
44
52
51
50
49
48
47
45
46
28
19
18
16
11
58
59
7
8
9
10
5
64
63
62
61
60
57
56
55
54
53
39
20
13
12
17
6
1
4
3
2

ME 3810-294-34/3-1

Figure 3-1. Alternator assembly, exploded view.

KEY to fig. 3-1.

1. Screw
2. Self-locking nut
3. Washer
4. Spacer
5. Drive end housing
6. Screw
7. Regulator
8. Ball bearing
9. Packing
10. Spacer
11. Packing
12. Screw
13. Receptacle
14. Seal
15. Seal
16. Screw
17. Lockwasher
18. Washer
19. Brush holder
20. Brush
21. Screw
22. Lockwasher
23. Cover
24. Screw
25. Screw
26. Clamp
27. Capacitor
28. Gasket
29. Screw
30. Washer
31. Fan
32. Key
33. Seal sleeve
34. Packing
35. Seal
36. Screw
37. Housing
38. Rotor
39. Intermediate housing
40. Ball bearing
41. Packing
42. Stator
43. Negative rectifier mount
44. Positive rectifier mount
45. Rectifier assembly
46. Rectifier assembly
47. Screw
48. Lockwasher
49. Guard washer
50. Washer
51. Insulator
52. Bushing
53. Screw
54. Insulator
55. Stud
56. Nut
57. Pin
58. Nut
59. Guard washer
60. Screw
61. Lockwasher
62. Plate
63. Gasket
64. Plug

a. Remove screws (1), nut (2), washer (3), spacer (4) and remove drive end housing (5), using a suitable pulley to remove housing from shaft.

b. Remove screws (6) and remove regulator (7) from drive end housing.

c. Press bearing (8) from drive end housing by pressing on pulley side of bearing. Remove packing (9) and spacer (10) from housing.

d. Remove packing (11). Remove screws (12) and remove receptable (13).

e. Remove seals (14 and 15).

f. Disconnect wires and remove screws (16), lockwashers (17), and guard washers (18) and remove brush holder (19). Remove brushes (20) from holder.

g. Remove screws (21) and lockwashers (22) and remove cover (23). Remove screws (24 and 25), clamp (26), and remove capacitor (27) and gasket (28) from intermediate housing.

h. Remove screw (29) and washer (30) and remove fan (31) and key (32) from rotor shaft. Remove seal sleeve (33), packing (34), and seal (35) from fan hub.

i. Remove screws (36) and remove housing (37) and rotor (38) from intermediate housing (39).

j. Use a suitable puller and remove housing (37) from rotor (38). Pull bearing (40) and packing (41) from rotor shaft. Remove stator (42).

k. Remove rectifier mounts (43 and 44) from intermediate housing. Remove rectifiers (45 and 46) from the rectifier mounts. Remove screws (47), lockwashers (48), guard washers (49), washers (50) and insulators (51). Remove bushings (52).

l. Remove screws (53) and insulators (54). Remove stud (55), nut (56) and pin (57).

m. Remove nut (58) and guard washer (59).

n. Remove screws (60), lockwashers (61), plate (62), and gasket (63). Remove plug (64).

3-4. Cleaning

Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air.

3-5. Inspection and Repair

a. Inspect all electrical parts for frayed or deteriorated insulation. Check all varnish and epoxy coated components for bare spots and recover if necessary.

b. Check rotor for wear on bearing surfaces and for loose or damaged slip rings. Replace rotor if worn or damaged.

c. Replace all packings and seals.

d. Perform electrical tests in accordance with TM 5-3810-294-20.

3-6. Reassembly and Installation

Refer to figure 3-1 and reassemble the alternator as follows.

a. Install stator (42) in intermediate housing (39). Press or tap stator to install in housing.

b. Install bushings (52). Install rectifiers (45 and 46) and insulators (51) on mounts (43 and 44) and install mounts in intermediate housing. Install nut (56), stud (55) insulator (54) and screws (53). Install washers (50), guard washers (49), lockwashers (48), and screws (47).

c. Press bearing (8), packing (9) and spacer (10) into drive end housing (5).

d. Install receptacle (13) and secure with screws (12).

e. Install regulator (7) and secure with screws (6). Install washer (59) and nut (58).

f. Press seals (15 and 14) in intermediate housing with smooth face of seal toward pulley end of alternator. Apply suitable grease in cavity between two seal lips.

g. Install rotor (38) in intermediate housing and stator. Cover shaft of rotor with suitable guide made of shim stock to prevent damage to seal when installing rotor.

h. Install brushes (20) in brush holder (19) and install brush holder in housing. Secure brush holder with screws (16), lockwashers (17) and guard washers (18).

i. Support rotor and stator on press and press drive end housing (5) on rotor shaft, using new packing (11). Secure housing with screws (1).

j. Install spacer (4), washer (3), and nut (2) on rotor shaft.

k. Install new packing (41) in bearing bore of housing (37). Install seal (35) in rotor side of housing with smooth face of seal toward rotor.

l. Install housing (37) on intermediate housing and secure with screws (36).

m. Apply suitable grease around rotor shaft and seal and press bearing (40) in housing and over shaft.

n. Install new packing (34) on shaft and install seal sleeve (33). Press outer seal (35) on shaft with smooth face of seal facing outward. Place suitable grease in seal sleeve before installing seal.

o. Install key (32) in shaft and install fan (31) on shaft. Secure fan with washer (30) and screw (29).

p. Install gasket (28) on intermediate housing. Install capacitor (27), clamp (26), and secure with screws (24 and 25). Install cover (23) and secure with screws (21) and lockwashers (22). Install pin (57).

q. Install gasket (63), plate (62), lockwashers (61) and screws (60). Install plug (64).

r. Refer to TM 5-3810-294-20 and install alternator on engine.

Section II. REPAIR OF STARTING MOTOR

3-7. Description

The starting motor is designed for high torque, short use applications. It engages the engine flywheel ring gear, and is used to crank the engine until it starts. When the engine starts, the starter motor automatically disengages.

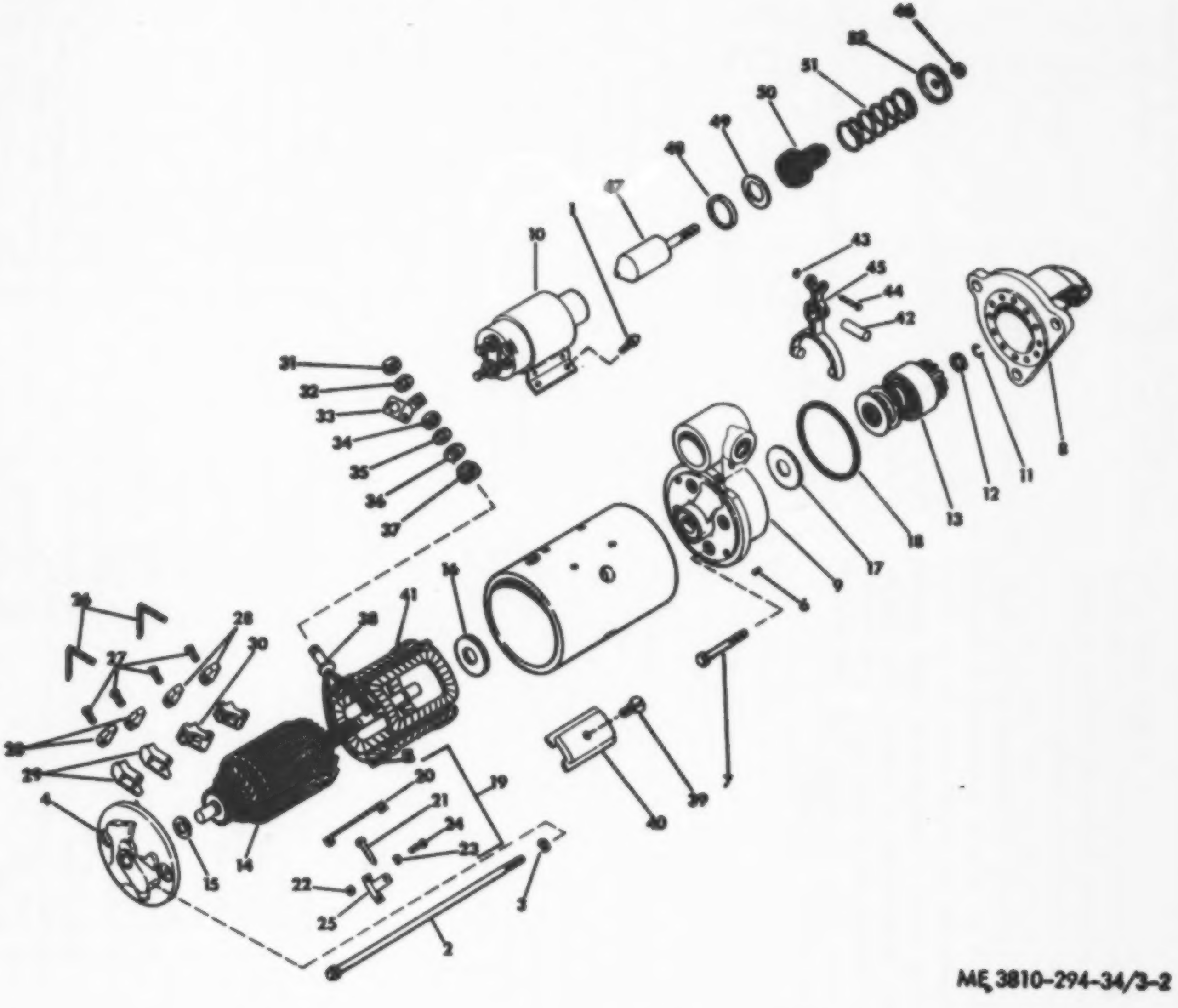
3-8. Removal

Refer to TM 5-3810-294-20 to remove the starting motor.

3-9. Disassembly

Refer to figure 3-2 and disassemble the starting motor as follows:

1. Screw
2. Thru-bolt
3. Lockwasher
4. Commutator end frame
5. Field frame
6. Dowel
7. Bolt
8. Nose housing
9. Lever housing
10. Solenoid
11. Retainer ring
12. Stop collar
13. Drive assembly
14. Armature
15. Washer
16. Washer
17. Brake washer
18. Field Coil Insulation
19. Brush support kit
20. Ground lead
21. Brush holder pin
22. Nut
23. Lockwasher
24. Screw
25. Brush support
26. Spring
27. Brush attaching screw
28. Brush
29. Brush holder
30. Brush holder
31. Nut
32. Lockwasher
33. Switch connector
34. Nut
35. Washer
36. Insulated washer
37. Insulated bushing
38. Terminal stud
39. Screw
40. Pole shoe
41. Field coil.
42. Lever
43. Snap ring
44. Pin
45. Shift lever
46. Snap ring
47. Plunger
48. Spring retainer
49. Washer
50. Boot
51. Spring
52. Spring retainer


46
52
51
50
49
48
47
1
10
43
45
44
42
8
11
12
13
18
17
9
6
7
31
32
33
34
35
36
37
16
41
38
26
27
28
30
28
29
4
15
14
20
21
34
23
19
22
25
3
2
39
40

ME 3810-294-34/3-2

Figure 3-2. Starting motor, exploded view.

a. Note the relative position of the solenoid (10), lever housing (7), and nose housing (8) so the motor can be reassembled with these parts in the same position.

b. Disconnect the connector on the field coil (41) from the terminal in the solenoid (10). Remove the screws (1).

c. Remove the thru-bolts (2) and lockwashers (3) and remove the end frame (4) from the field frame (5). Remove the field frame (5) and dowels (6) from the lever housing (9).

d. Remove the bolts (7) and separate the nose housing (8) from the lever housing (9).

e. Slide a standard half-inch coupling or a metal cylinder of suitable size over the armature shaft so the cylinder butts against the collar (12). Tap the cylinder with a hammer to drive the collar toward the armature and off the snap ring (11). Remove the snap ring and collar.

f. Remove the drive (13), armature (14), washers (15, 16 and 17), and coil insulation (18).

g. Disconnect the lead (20) and remove the other parts (21 through 25) of the brush support kit (19). Remove the springs (26) and disassemble the brushes (28) from the holders (29 and 30) by removing the screws (27).

h. Remove the nut (31), lockwasher (32) and connector (33). Remove the nut (34), washers (35 and 36), insulated bushing (37) and stud (38).

i. Remove the screws (39) with a pole shoe screwdriver. Remove the shoes (40) using a spreader. Remove the field coil (41) being careful not to distort the field frame,

j. Drive out the lever (42). Remove the snap ring (43) and pin (44) to disassemble the shift lever (45) from the plunger (47).

k. Remove the snap ring (46) and disassemble the plunger (47), retainer (48), washer (49), boot (50), spring (51) and retainer (52).

3-10. Cleaning

a. Clean all parts except the drive (13) with dry cleaning solvent (Federal Specification P-S-661) and dry with compressed air. Clean the drive with a clean cloth.

Caution: **Do not clean the drive, armature (14) or field coils (41) in a degreasing tank or with grease dissolving solvents since this would dissolve lubricants and damage insulation.**

b. Clean the commutator with No. 00 sandpaper.

Caution: **Do not use emery cloth.**

3-11. Inspect and Repair

a. Check all housings for cracks or other damage, particularly the sealing surfaces. Replace any damaged housings.

b. Check the commutator end frame and replace if it is cracked or distorted.

c. Replace the armature if the bearing surfaces are worn. If the commutator is worn, dirty, out of round, or has high insulation, turn it down on a lathe. After turning, undercut the insulation to 1/32 inch wide and deep. Lightly sand the commutator with No. 00 sandpaper. Remove all dirt and copper dust. Check the commutator bars for opens, shorts and grounds with a growler or test lamp.

d. Check the teeth on the drive pinion and replace the drive if the teeth are worn or damaged.

e. Replace the shift lever if it is cracked or distorted.

f. Replace worn or cracked brushes and damaged brush springs. Check the solenoid spring for damage and the boot for deterioration or puncture. Replace all imperfect parts.

g. Replace the field coil if a test with a lamp shows open circuits or grounds.

h. Replace all snap rings and all hardware with stripped threads or other damage.

3-12. Reassembly and Installation

Refer to figure 3-2 and reassemble the starting motor as follows:

a. Set bushing (37) on stud (38). Carefully install the field coil (41) in the frame (5) and insert the insulation (18) between the coil and frame.

b. Set the pole shoes (40) in place and secure them with the screws (39) using a pole shoe screwdriver.

c. Install the two washers (35 and 36), nut (34), connector (33), lockwasher (32) and nut (31).

d. Place retainer (48), washer (49), boot (50), spring (51) and retainer (52) on the shaft of the plunger (47) and secure the parts with snap ring (46). Assemble the shift lever (45) to the end of the plunger (47) with pin (44) and snap ring (43).

e. Set the lever (45) and assembled parts in the lever housing (9) and secure it in place with the lever (42).

f. Install the brushes (28) in the brush holders (29 and 30) and secure with screws (27).

g. Assemble the support (25), screw (24), lockwasher (23), nut (22) and pin (21) of the brush support kit (19). Install these parts and the assembled brushes with the springs (26). Connect the ground lead (20).

h. Insert the armature shaft through the washer (16), lever housing (9), washer (17), drive assembly (13), stop collar (12) and snap ring (11). Place the snap ring in the armature shaft groove. Slip a washer onto the shaft and slide the washer down to the snap ring. Using two sets of pliers force the stop collar (12) over the snap ring. Remove the washer.

i. Assemble the nose housing (8) to the lever housing and secure with bolts (7).

j. Install dowels (6). Set the field frame (5) over the armature onto the lever housing. Install washer (15) and end frame (4) and secure the end frame with thru-bolts (2) and lockwashers (3).

k. Place the solenoid (10) on the field frame, insert the plunger (47) in the solenoid, aline the mounting holes of the solenoid and field frame and secure with screws (1).

l. Saturate the three oiling wicks with No. 10 oil.

m. Check drive pinion clearance as follows: Disconnect field coil connection from solenoid motor. Connect a battery of the same voltage as the solenoid to the solenoid switch terminal and to the solenoid frame or ground terminal. Momentarily flash a jumper from the solenoid motor terminal to the solenoid frame or ground terminal. This will shift the drive into cranking position. Using a feeler gage measure the clearance between the drive pinion and stop collar (12). Move drive assembly by hand to give a clearance of .010 to .140 between the pinion and collar. Remove jumpers and replace connection between field coil and solenoid.

n. Refer to TM 5-3810-294-20 and install the starting motor on the engine.

Section III. REPAIR OF DISTRIBUTOR

3-13. Description

The distributor opens and closes the circuit between the low voltage source and the ignition coil so that the primary coil winding of the coil obtains intermittent surges of current. These surges build up magnetic fields around the primary coil. When the surge of current stops as the points open, the collapse of the magnetic field induces a high voltage surge in the coil secondary winding. This high voltage surge is directed to the spark plugs to ignite the fuel. The distributor also is used to time these surges of spark plug power for most efficient engine operation.

3-14. Removal

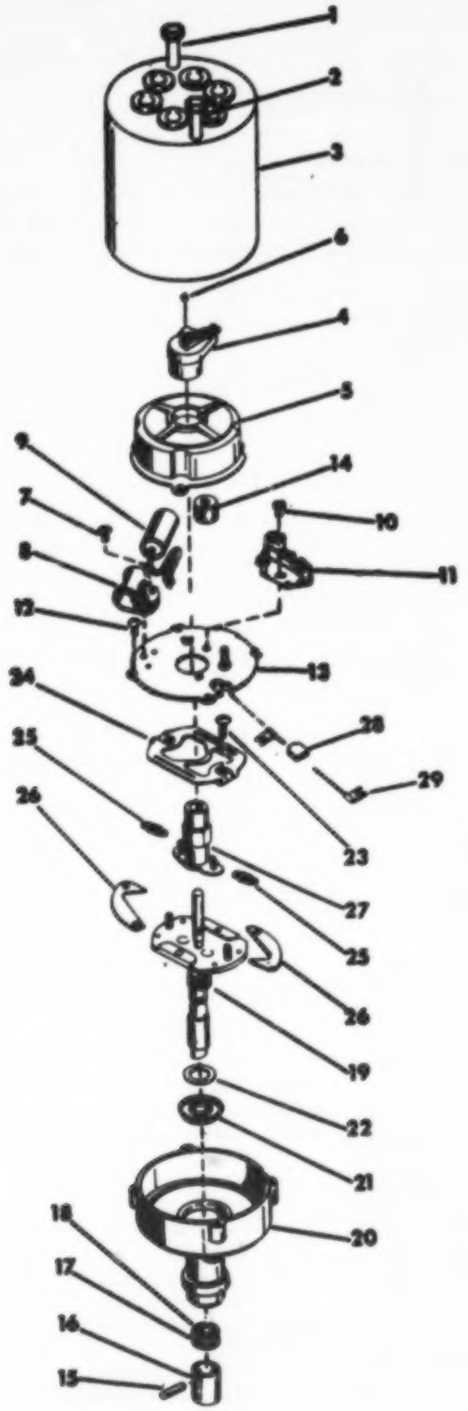
Refer to TM 5-3810-294-20 to remove the distributor from the engine.

3-15. Disassembly

Refer to figure 3-3 and disassemble the distributor as follows:

KEY to fig. 3-3.

1. Screw
2. Screw
3. Cap
4. Rotor
5. Dust seal
6. Carbon button
7. Screw
8. Condenser bracket
9. Condenser
10. Adjusting screw
11. Contact set
12. Screw (4)
13. Breaker plate
14. Wick
15. Pin
16. Coupling
17. Shim washer
18. Shim washer
19. Shaft and weight plate
20. Housing
21. Seal
22. Space washer
23. Screw
24. Plate
25. Spring (2)
26. Weight (2)
27. Breaker cam
28. Grommet
29. Lead



ME 3810-294-34/3-3

Figure 3-3. Distributor, exploded view.

a. Remove screws (1 and 2). Lift off the cap (3), rotor (4) and dust seal (5). Remove the carbon button (6).

b. Remove the screws (7) and the bracket (8) and condenser (9).

c. Remove the screw (10) and the contact set (11).

d. Remove the screws (12) and the breaker plate (13) and wick (14).

e. Grind or file off the peened over head of pin (15) and drive out the pin. Remove the coupling (16) and shim washers (17 and 18).

f. Lift out shaft and weight plate (19) with the attached parts from the housing (20). Remove the seal (21) and washer (22).

g. Remove the screw (23) and plate (24).

h. Unhook the two springs (25) and remove the two weights (26) and cam (27).

i. Take out the grommet (28) and lead (29).

3-16. Cleaning

Clean all metal parts with dry cleaning solvent (Federal Specification P-S-661 and dry with compressed air. Wipe all other parts clean with a piece of dry cloth.

3-17. Inspection and Repair

a. Check the cam (27), weights (26), springs (25) and the shaft and weight plate (19) for wear. Replace if necessary.

b. Replace the contact set (11) if the points are worn or pitted or if the rubbing block or bushing are worn excessively.

c. Replace the wick (14) if it is worn, hard or dirty.

d. Replace the carbon button (6) if it is worn.

e. Check all other parts for signs of physical damage. Replace if necessary.

3-18. Reassembly and Installation

Refer to figure 3-3 and reassemble the distributor as follows:

a. Set the weights (26) and cam (27) on the shaft (19) and install the springs (25).

b. Install the plate (24) and secure it with the screws (23).

c. Place the washer (22) and seal (21) on the shaft (19) and set the shaft into the housing (20).

d. Install the washers (18 and 17) and coupling (16) on the shaft. Insert a new pin (15) and peen the head to secure the coupling.

e. Install the breaker plate (13) and secure it with the screws (12).

f. Install the grommet (28), lead (29) and wick (14).

g. Install the contact set (11) and secure it with the screw (10). Adjust the point gap as outlined in TM 5-3810-294-20.

h. Install the condenser (9) in the bracket (8) and attach the bracket to the plate with screws (7).

i. Set the dust seal (5) in place. Oil the wick (14) and install the rotor (4).

j. Install the carbon button (6) in the cap (3). Install the cap and secure it with screws (2 and 1).

k. Install the distributor as outlined in TM 5-3810-294-20.

Section IV. REPAIR OF CARBURETOR

3-19. Description

The carburetor is of the updraft double venturi type. It is designed to maintain proper fuel mixtures even though the vehicle is on very steep slopes. It is a "sealed and balanced" type, in that all air for bowl chamber ventilation and idling must come through the air filter.

3-20. Removal

Refer to TM 5-3810-294-20 for instructions to disconnect the fuel lines, controls, linkages, and removal of the carburetor from the engine.

3-21. Disassembly

Refer to figure 3-4 and disassemble the carburetor as follows:

KEY to fig. 3-4.

1. Flange gasket
2. Screw & lockwasher (2)
3. Throttle plate
4. Screw (6)
5. Lockwasher (6)
6. Felt seal
7. Throttle shaft bearing
8. Seal retainer
9. Throttle shaft
10. Throttle lever and stop lever
11. Throttle stop screw
12. Pin
13. Venturi screw
14. Lockwasher
15. Throttle body
16. Pump assembly
17. Float assembly
18. Gasket
19. Venturi
20. Well vent jet
21. Accelerating jet
22. Accelerating jet washer
23. Screw
24. Lockwasher (3)
25. Choke plate
26. Choke shaft
27. Nut
28. Choke bracket
29. Choke bracket clip
30. Screw
31. Choke lever screw
32. Choke lever nut
33. Lockwasher
34. Choke lever
35. Choke return spring
36. Bracket retaining screw
37. Fuel bowl
38. Plug
39. Plug
40. Discharge jet washer
41. Discharge jet
42. Washer
43. Plug
44. Plug
45. Washer
46. Main jet
47. Main jet washer
48. Washer
49. Plug
50. Check valve
51. Power jet valve
52. Float axle
53. Fuel needle valve
54. Fuel valve seat
55. Valve seat washer
56. Idle jet
57. Idle needle spring
58. Idle adjusting needle
59. Throttle shaft bearing
60. Cup plug
61. Vacuum channel screw
62. Filter element
63. Washer
64. Filter head

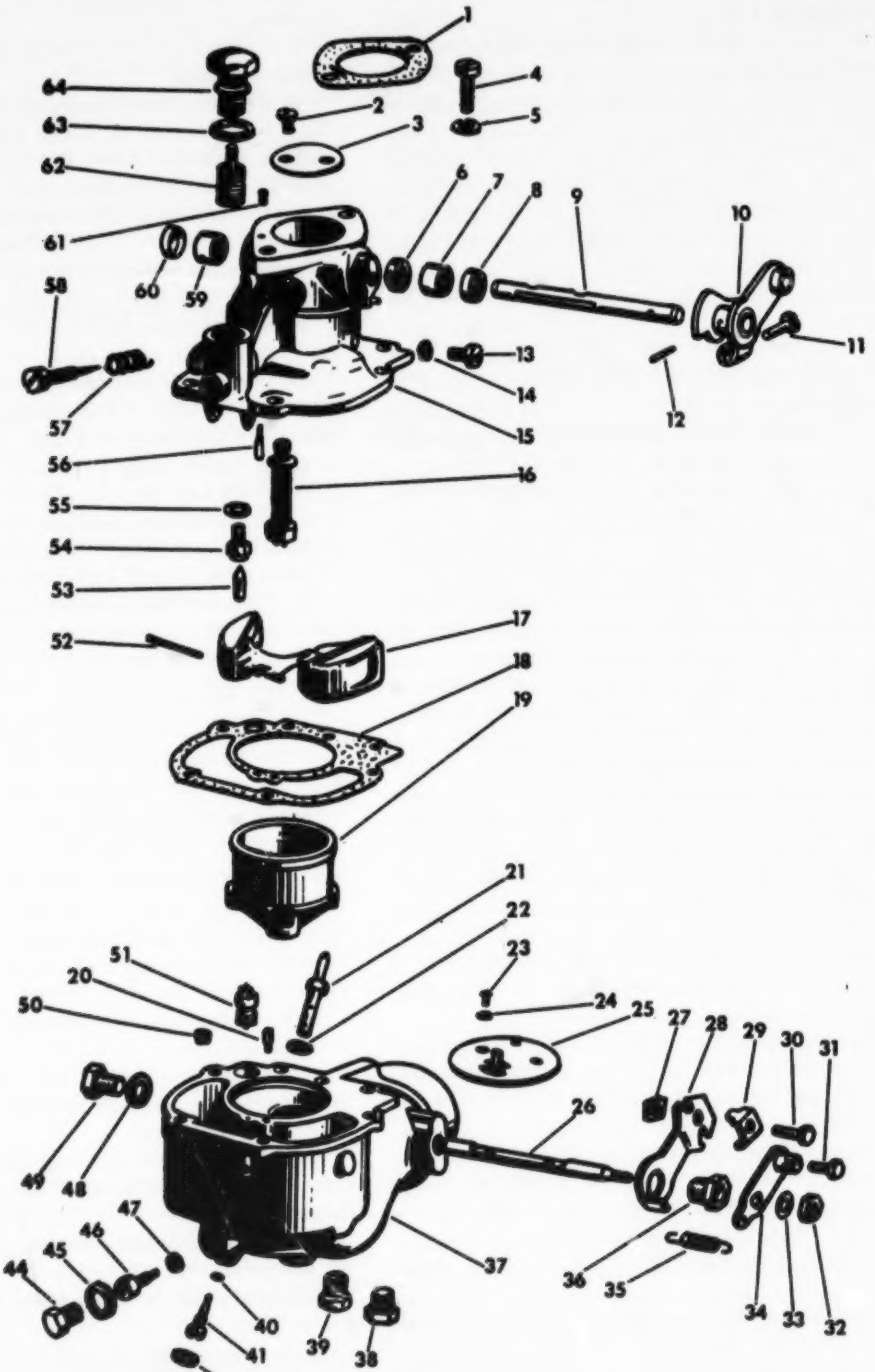

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
ME 3810-294-34/3-4

Figure 3-4. Carburetor, exploded view.

a. Remove filter head (64), washer (63) and filter (62) from throttle body.

b. Remove six throttle body to bowl screws (4), and lockwashers (5).

c. Pry throttle body assembly up slightly from fuel bowl and loosen gasket (18) from fuel bowl. Lift off throttle body being careful to avoid damaging the float assembly.

d. Invert throttle body and remove bowl to body gasket (18) from machined surface of throttle body. Then remove pump assembly (16) by pushing in on piston and then pulling out sharply to unseat piston retainer in throttle body recess.

e. Remove float axle (52) and float assembly (17).

f. Remove fuel needle valve (53) from seat. Then remove valve seat (54) and fiber washer (55) from throttle body.

g. Remove idle jet (56) from passage near fuel valve seat.

h. Remove idle adjusting needle (58) and spring (57) from side of throttle body.

i. Remove venturi screw (13) and lockwasher (14 from side of throttle body and then remove venturi.

j. File off riveted end of throttle plate screws flush with throttle shaft, being careful not to damage throttle plate or throttle bore.

k. Back out throttle stop screw (11) until end of screw is flush with stop lever. Then close throttle lever, and mark across throttle body and lever as a guide to correct re-assembly of parts.

l. Remove throttle plate screws (2), throttle plate (3) and then remove throttle shaft and lever assembly (9, 10, 11 and 12) from throttle body.

Caution: Do not remove throttle shaft bearings unless new bearings are available for replacement.

m. Insett a long rod through retainer on throttle lever side of throttle body, and drive cup plug (60) out of throttle body.

n. Thread a screw extractor tool into needle bearing assembly, and then use a rod to drive against end of tool until bearing (59) is free of throttle body.

o. Thread a screw extractor tool into retainer (8). Then insert rod from opposite side of throttle body and drive out retainer. Repeat step n to remove bearing (7) from throttle body.

p. Remove felt seal (6) from throttle body opening.

q. Remove plug (44), washer (45), plug (43) and washer (33) from fuel bowl.

r. Remove plugs (38 and 39) from bottom of fuel bowl.

s. Remove power and accelerating jet (41) and washer (40) from threaded angle passage in outside bottom of fuel bowl.

t. Remove main jet (46) and washer (47) from threaded passage in side of fuel bowl.

u. Remove well vent jet (20) from center of large opening in fuel bowl.

v. Remove power jet valve (51) from bottom of pump cylinder.

w. Remove main discharge jet (21) and washer (22) from center of large opening in machined surface of bowl.

x. To remove check valve (50), thread a screw extractor tool into check valve until tool is firmly fastened in valve body. Then pull outward on extractor tool to unseat check valve, and remove valve and tool from fuel bowl.

y. Mark across choke lever, choke bracket and air intake body as a guide to correct reassembly. Then remove choke spring (35).

z. Remove choke lever nut (32), lockwasher (33) and lever assembly (34 and 31).

aa. Remove plug (49) and washer (48) from choke shaft hole on opposite side of air intake body.

ab. Remove screws (23) and lockwashers (24) and choke plate (25) from air intake opening. Then remove choke shaft (26) from choke shaft hole.

ac. Remove choke bracket retaining screw (36) and choke bracket assembly (27, 28, 29 and 30) from side of air intake.

3-22. Cleaning

Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air. Blow out all passages in the air intake, throttle body, and fuel bowl. Clean all carbon deposits from throttle bore and idle port.

3-23. Inspection and Repair

a. Replace float if loaded with fuel, float is damaged, or if float axle bearing is worn. Inspect float for wear on top side where float contacts fuel valve needle.

b. Replace float axle if axle is worn, bent, or damaged.

c. Replace fuel valve seat and needle because both parts are subject to wear and could cause improper float level.

d. Replace idle adjusting needle and spring if wear is evident or if needle is not smooth and free of ridges.

e. Replace throttle and choke plates if worn, bent or damaged.

f. Replace pump assembly if wear and bending are evident.

g. Replace power jet valve (51).

h. Replace throttle and choke shafts if wear is evident on bearing surfaces.

i. Replace entire carburetor if fuel bowl or throttle body are worn or damaged or if parts do not fit properly in passages.

j. Replace throttle shaft needle bearings if side play of a new shaft is in excess of 0.005 inch.

3-24. Reassembly and Installation

a. Insert choke shaft (26) in shaft holes and rotate shaft so that flat side is down.

b. Insert choke plate (25) into air intake with spring of poppet valve down.

c. Center choke plate on shaft and close choke plate. Aline holes in plate with holes in shaft and install screws and lockwashers (24) loosely.

d. Tap choke plate lightly to center plate and then tighten both screws evenly and firmly.

Note. Be sure that poppet spring is outward when choke plate is closed.

e. Place choke bracket assembly (27, 28, 29 and 30) on bracket retaining screw (36) and attach bracket to air intake in same position it was in before removal (refer to marks made before disassembly.

f. Place choke lever assembly (34 and 31) on shaft (in same position it was in before removal), and secure with nut (32) and lockwasher (33).

g. Install choke return spring (35).

h. Assemble plug (49) and washer (48) in choke shaft hole on opposite side of air intake.

i. Place fiber washer (22) on main discharge jet (21) and assemble jet in fuel bowl. Tighten firmly.

j. Assemble well vent jet (20) in fuel bowl and tighten lightly.

k. Assemble fiber washer (40) on power and accelerating jet (41) and install jet in threaded angle passage in bottom of fuel bowl. Place fiber washer (42) on plug (43), and install plug on passage over power jet.

l. Assemble fiber washer (47) on main jet (46) and install jet in large threaded passage in side of fuel bowl. Place fiber washer (45) on plug (44) and install plug in passage over main jet.

m. Install plugs (38 and 39) in bottom of fuel bowl.

n. Install power jet valve (51) in bottom of pump cylinder.

o. To install check valve assembly (50), start check valve into counterbore in bottom of fuel bowl with small opening out and aline valve so that it is not cocked. Use a ¼" punch and a light hammer to drive the valve squarely into the channel. Top of valve should be just below top end of channel when in place.

Note. Steps should be performed only if the old bearings were removed and new bearings are being installed.

p. Assemble felt seal (6) in bottom of throttle shaft counterbore on side of throttle body where throttle lever will be installed.

q. Position bearing (7) squarely in counterbore and use a ⅜" rod with a flat end and a light hammer to drive bearing into counterbore. When fully seated, the outer end of the bearing should be .180" below the machined surface adjacent to the throttle shaft counterbore.

r. Position retainer (8) in counterbore with lip or retainer toward the throttle bore, and use ⅜" rod to press retainer into counterbore so that retainer is slightly (.030" to .040") below the machined surface adjacent to the throttle shaft counterbore.

s. Repeat Step 2 to install bearing (59) in counterbore on opposite side of throttle bore except that the outer edge of this bearing should be .310" below machined surface adjacent to throttle shaft counterbore.

t. Install cup plug (60) in counterbore (with lip of plug outward). Plug should be seated so that lip is slightly (.030" to .040") below machined surface adjacent to throttle shaft counterbore.

u. Assemble throttle shaft and lever assembly (9, 10, 11 and 12) in throttle body and position according to match marks made at time of disassembly.

v. Insert throttle plate (3) in throttle shaft in same position it was in before disassembly. Center plate and then rotate shaft (counter-clockwise) to closed position. Hold throttle plate closed and start screws (2) into shaft. Tap plate lightly to center in bore and then tighten screws.

w. Install idle adjusting needle (58) and spring (57) in threaded passage on side of throttle body. Turn idle needle in lightly against its seat, then back out needle 1¼ turns

x. Insert venturi assembly (19) in throttle body, large opening first. Rotate venturi to aline screw hold in throttle body. Install screw (13) and lockwasher (14) and tighten screw.

y. Assemble idle jet (56) in counterbored hole in machined surface near venturi.

z. Assemble washer (55) on fuel valve seat (54) and install seat in throttle body. Place fuel needle valve (53) in seat.

aa. Position float assembly (17) in hinge bracket and insert float axle (52) through hinge bracket and float lever bushing from side opposite slotted end of bracket.

ab. With throttle body inverted, check the float setting. The dimension from the top of the floats to the machined surface (without gasket) should be 1-19 / 32". To increase or decrease this distance, use long nose pliers to bend float lever close to float body.

Note. Do not bend, twist or apply pressure on float bodies. The float bodies when viewed from the free end of the bodies must be centered and at right angles to the machined surface and must move freely on the float axle.

ac. Assemble vacuum piston assembly (16) in vacuum cylinder in throttle body. Press retainer into recess of body with flat side of screwdriver. Check for free movement of piston in cylinder.

ad. Place throttle body gasket (18) on machined surface of throttle body.

ae. Place throttle body on fuel bowl being careful not to damage floats or vacuum piston assembly.

af. Aline holes in throttle body and gasket with holes in fuel bowl and install six screws (4) and lockwashers (5). Tighten screws uniformly and securely.

ag. Install fuel filter (62), fiber washer (63) and filter head (64) in threaded passage in top of throttle body.

ah. Hold throttle closed and turn throttle stop screw (11) in until it just contacts stop on throttle body; then turn screw in 1½ additional turns as a preliminary idle speed adjustment.

ai. Refer to TM 5-3810-294-20 and install the carburetor, throttle linkage, and fuel lines on engine. Adjust carburetor as described in TM 5-3810-294-20.

Section V. REPAIR OF GOVERNOR

3-25. Description

The governor, in conjunction with the throttle, maintains engine speed in response to changes in load. An example of a change in engine load occurs when the crane operator begins to lift a load. At this time, the speed govenor senses a tendency for the engine to slow down. This automatically causes the governor linkage to open the carburetor throttle valve, thus allowing more fuel to enter the engine. The additional fuel prevents the engine from slowing down, and the governor has maintained the engine at the desired speed, which is represented by the throttle setting.

3-26. Removal

Refer to TM 5-3810-294-20 to remove the governor.

3-27. Disassembly

Refer to figure 3-5 and disassemble the governor as follows.

KEY to fig. 3-5
1. Rockshaft
2. Governor spring
3. Stop pin
4. Throttle lever
5. Stop screw
6. Bumper spring body
7. Bumper spring
8. Locating screw
9. Thrust fork
10. Rockshaft
11. Connecting rod
12. Thrust bearing stop ring
13. Thrust bearing
14. Thrust sleeve
15. Governor weights
16. Weight pin
17. Governor carrier
18. Governor weight carrier, assembly
19. Drive gear, with shaft
20. Woodruff key
21. Gear spacer
22. Drive shaft bearing
23. Bearing spacer
24. Drive housing
25. Gear spacer
26. Stepup gear
27. Gasket
28. Cover
29. Elbow (at engine)
30. Elbow (at cover)
31. Lubrication tube

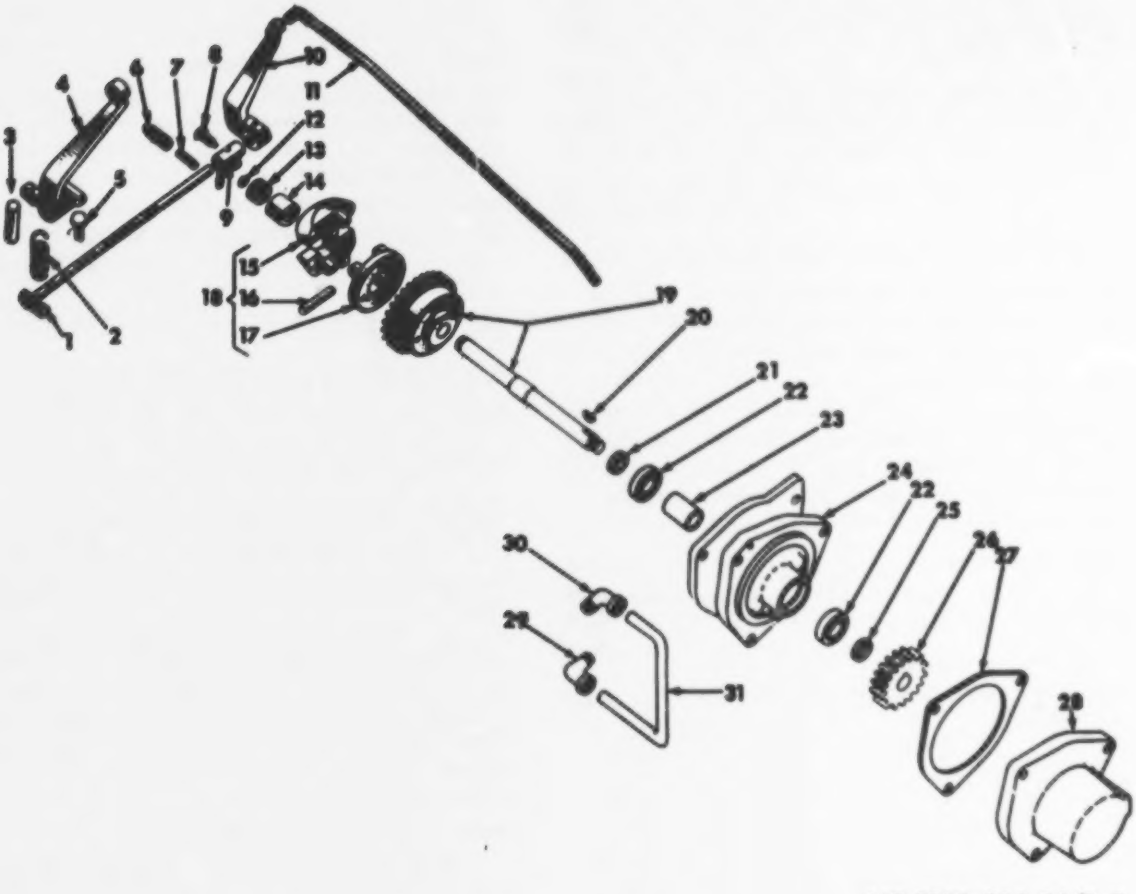


Figure 3-5. Governor, exploded view.

a. Remove drive housing cover (28) and gasket (27) from drive housing (24).

b. Remove step-up (26), key (20) and spacer (25). Pull out drive shaft (19).

c. Remove spacer (23) from drive shaft.

d. Remove stop ring (12), thrust bearing (13) and thrust sleeve (14) from drive shaft.

e. The governor carrier (17) and drive gear (19) are attached to each other with four cap screws and four lock washers. Remove the cap screws and governor carrier.

f. Remove cotter pin from weight pins (16) and drive out pin to remove the weights.

g. Press out the bushings from the drive housing (21) if they need replacing.

3-28. Cleaning, Inspection and Repair

a. Clean all parts thoroughly and dry off with compressed air.

b. Inspect all parts for wear or damage and replace with new parts where necessary.

c. Be sure that all oil holes and passages are open and clean.

d. Remove any burrs found on the drive gear or shaft with a stone.

3-29. Reassembly

a. Assemble governor weights (15) in carrier (17), using two pins (16) and two cotter pins. The pins (16) are drilled at one end, and are to be assembled in the carrier so the holes will line up to take the cotter pin. Be sure the carrier (17) turns freely when positioned in the counterbore of gear (19).

b. If inspection proves the drive shaft and gear (19) to be in good order (neither are serviced separately), secure governor weight carrier assembly (18) to gear with four cap screws from the back of the gear.

c. If bushings (21) are to be replaced with new ones, press them into the drive housing (24) and ream the bushings to .874 — .875 inch.

d. Install spacer (23) and place shaft, as it is now assembled, in the drive housing, after first wiping some SAE-30 lubricating oil on the housing end of the shaft.

e. Install spacer (25), key (20) and gear (26) on drive shaft (19).

f. Install a new gasket (27) and drive housing cover (28) with three capscrews to the drive housing (24).

g. Place thrust sleeve (14) and thrust bearing (13) on the drive end of the shaft. Fit stop ring (12) in the groove of the shaft.

Note. Lubricate bearing (13) with SAE-30 lubricating oil after it is assembled.

3-30. Installation

Refer to TM 5-3810-294-20 to install and adjust the governor assembly.

Section VI. REPAIR OF WATER PUMP

3-31. Description

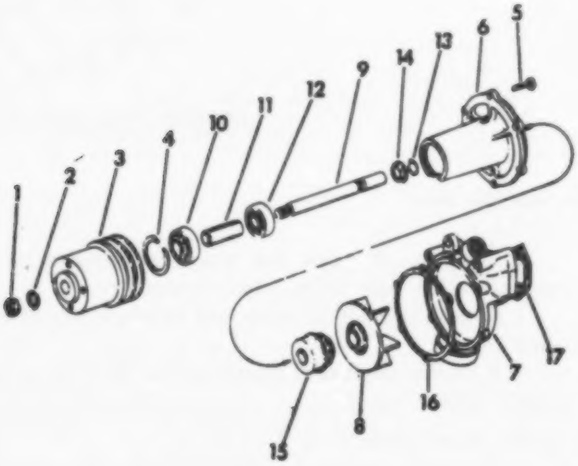
The water pump is belt driven by the engine fan pulley. It consists essentially of a two piece body and a shaft mounted impeller. Impeller rotation drives coolant throughout the cooling system by centrifugal force.

3-32. Removal

Refer to TM 5-3810-294-20 to remove the water pump.

3-33. Disassembly

Refer to figure 3-6 and disassemble the water pump as follows:



ME 3810-294-34/3-6

1. Pulley nut
2. Pulley washer
3. Pump pulley
4. Snap ring
5. Bolt
6. Bearing housing
7. Pump body
8. Impeller
9. Pump shaft
10. Front bearing
11. Bearing spacer
12. Rear bearing
13. Lock ring
14. Slinger
15. Seal
16. Gasket
17. Gasket

Figure 3-6. Water pump, exploded view.

a. Remove the nut (1), washer (2) and press the pulley (3) off the shaft (9).

b. Remove the snap ring (4).

c. Remove the bolts (5) and separate the bearing housing (6) from the pump body (7).

d. Press the shaft (9) out of the impeller (8).

e. Press off the bearing (10), spacer (11) and bearing (12). Remove the lock ring (13) and slinger (14).

f. Remove the seal (15) from the housing (6) and remove the gaskets (16 and 17).

3-34. Cleaning

Clean all parts except rubber parts in dry cleaning solvent (Federal Specification P-S-661) and dry with compressed air.

3-35. Inspection and Repair

a. Replace the pump seal and gaskets if they are worn or damaged.

b. Replace the impeller if the seal seat surface is scored.

c. Replace the bearings if they are worn.

d. Replace the shaft and housings if they are damaged.

3-36. Reassembly and Installation

Refer to figure 3-6 and reassemble the water pump as follows:

a. Place the seal (15) in the housing (6).

b. Press the bearing (12), spacer (11) and bearing (10) onto the shaft (9).

c. Press the shaft (9) with the bearings into the bearing housing (6). Install the slinger (14), lock ring (13) and snap ring (4).

d. Press the impeller (8) onto the shaft (9).

e. Set the gasket (16) in place. Assemble the body (7) to the bearing housing and secure with the bolts (5).

f. Press the pulley (3) onto the shaft and secure the pulley with the washer (2) and nut (1).

g. Set the gasket (17) in place and install the pump as outlined in TM 5-3810-294-20.

3-37. Description

The cooling system consists of a radiator, water pump, thermostat, fan, and hoses, lines, and fittings required to conduct coolant through the engine to the radiator and back to the engine to complete the cooling circuit. Drain valves are located on the lower radiator hose connection and at the right rear of the engine block to drain the radiator and block.

3-38. Removal

Refer to TM 5-3810-294-20 and remove the radiator and fan.

3-39. Cleaning, Inspection and Repair

a. Flush the inside of the radiator with a suitable cleaning solution. Avoid high pressure so as not to damage the radiator core.

b. Clean radiator core with compressed air or water under pressure from the fan side.

c. Clean the overflow line with compressed air.

d. Test radiator for leaks with air pressure. Use a suitable adapter to connect air hose to radiator outlet pipe and plug all other openings. Submerge radiator in a tank of water and apply 5 psi air pressure.

e. Repair leaks using soft solder which has a 34-35% tin content and 55-65% lead. Flux shall be zinc choloride or resin. Flush liberally with water after soldering has been completed. Straighten any fins that restrict air flow.

Note. Be sure repair does not restrict coolant circulation.

f. Clean fan; fan guard and attaching hardware in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air.

g. Inspect fan blades for cracked or bent condition. Replace a defective fan.

h. Inspect fan guard for broken wire and other damage. Repair or replace a defective fan guard.

i. Inspect mounting hardware for damage. Replace damaged hardware items.

3-40. Installation

Refer to TM 5-3810-294-20 and install fan and radiator.

CHAPTER 4

REPAIR OF CRANE ENGINE

Section I. GENERAL

4-1. Description

The crane engine is an in-line, 6 cylinder, International Harvester engine model U-450.

4-2. Engine Removal

Refer to paragraph 2-13 and remove the engine from the crane. Install the engine on a suitable overhaul stand for ease of disassembly operation detailed below.

4-3. Removal of Accessories

a. Refer to TM 5-3810-294-20 and remove the following from the engine.

(1) Oil filters and lines
(2) Governor and throttle controls
(3) Tachometer drive mechanism
(4) Fuel pump, fuel filter, and fuel lines
(5) Air cleaner and breather system
(6) Carburetor
(7) Muffler and exhaust pipe
(8) Radiator and fan
(9) Oil cooler
(10) Electrical components including generator, starting motor, plugs, distributor, sending units, and wiring.
(11) Water pump
(12) Manifolds

b. With the above accessories removed from the engine, the following disassembly and repair procedures can be accomplished.

Section II. REPAIR OF CYLINDER HEAD, ROCKER ARM AND VALVES

4-4. Description

An overhead type valve mechanism is used on this engine. The rocker arm shaft assembly is mounted to the top of the cylinder head and is lubricated by pressurized oil from a rifle-drilled passage running through the crankcase and head. A crankcase breather, connected to the top of the cylinder head cover, aerates the valve chamber enclosed by the cylinder head cover. The cylinder head is a one-piece casting and is stud mounted to the top of the crankcase.

4-5. Removal of Head

Refer to figure 4-1 and remove head as follows.

Key to fig. 4-1
1. Crown nut (4)
2. Washer (4)
3. Cylinder head cover
4. Gasket
5. Bolt (8)
6. Stud (4)
7. Washer (2)
8. Washer (4)
9. Head bolt-oil
10. Oil bolt gasket
11. Pushrods (12)
12. Headbolt-short (11)
13. Headbolt-long (10)
14. Washer (21)
15. Oil bolt washer
16. Lifting eye
17. Head
18. Head gasket
19. Tube (6)
20. Cup (6)
21. Lock (12)
22. Retainer (6)
23. Inner spring (12)
24. Outer spring (12)
25. Lower spacer (12)
26. Retainer lock (12)
27. Retainer (6)
28. Intake valve (6)
29. Exhaust valve (6)
30. Valve guide (6)
31. Valve guide (6)
32. Oil seal (6)
33. Exhaust valve seat ring (6)
34. Intake valve seat ring (6)
35. Tappets (12)
36. Retainers (2)
37. Washer (2)
38. Spring (2)
39. Adjustment nut (12)
40. Adjustment screw (12)
41. Rocker arm (12)
42. Bushing (12)
43. Bracket (6)
44. Spring (4)
45. Expansion plug (2)
46. Shaft (front)
47. Coupling
48. Shaft (rear)
49. Oil connector

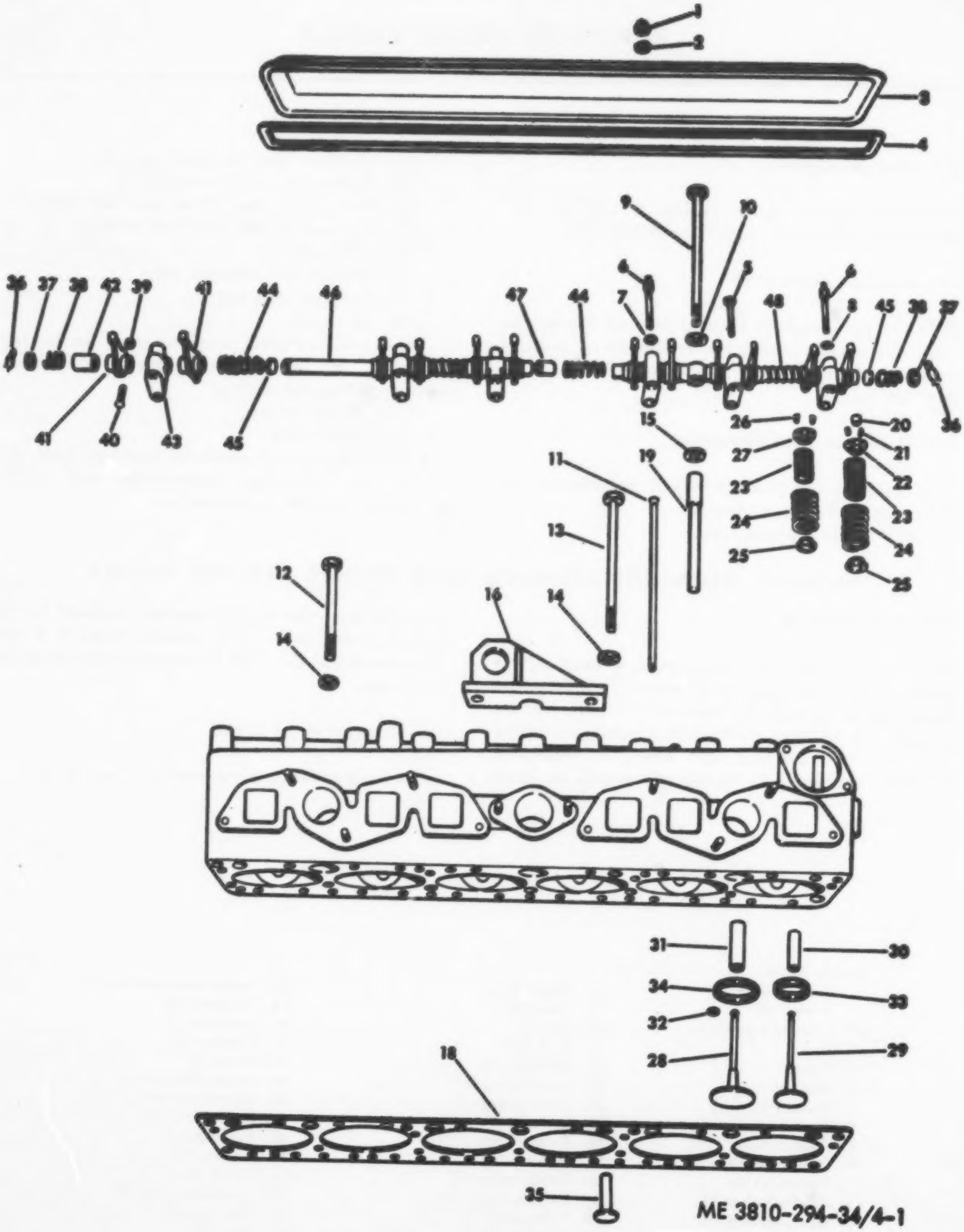

1
2
3
4
9
10
6
5
6
36
37
38
42
39
41
44
46
47
44
7
48
8
45
38
37
41
40
43
45
15
26
20
21
27
22
23
23
24
24
25
25
36
11
19
13
12
14
16
14
31
30
34
33
32
18
28
29
35
ME 3810-294-34/4-1

Figure 4-1. Cylinder head, rocker arm, and valve, exploded view.

a. Remove crown nuts (1), washers (2) and lift cylinder head cover (3). Remove gasket (4).

b. Remove bolts (5), studs (6), and washers (7 and 8) from rocker arm shaft brackets. Remove the rocker arm assembly as a unit and oil bolt (9) and gasket (10). Remove pushrods (11).

Note. Mark pushrods for installation in identical position at reassembly.

c. Remove head bolts (12 and 13) and washers (14 and 15).

d. Using lifting eye (16), remove head (17) and gasket (18). Remove oil tube (19).

4-6. Disassembly

Refer to figure 4-1 and disassemble head, valves, and rocker arm as follows:

a. Remove exhaust valve tip cup (20). Compress valve spring with a valve compressor and remove valve spring retainer lock (21). Remove retainer (22), inner spring (23), outer spring (24), and lower spacer (25).

b. In like manner, remove retainer lock (26) from intake valve (28), retainer (27), inner spring (23), outer spring (24), and lower spacer (25).

c. Remove intake valves (28) and exhaust valves (29). Remove valve guides (30 and 31). Remove valve seat rings (33 and 34). Remove tappets (35).

d. Remove retainer (36), washer (37) and spring (38). Remove adjustment nut (39), adjustment screw (40), and rocker arm (41).

e. Remove bushing (42) from bracket (43). Slide spring (44) from shaft and remove plug (45). Remove shaft (46), coupling (47), and shaft (48). Remove oil connector (49).

4-7. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Coat all machine surfaces with light oil to prevent rusting.

b. Clean all oil passages with brass probes and flush with cleaning solvent. Blow dry with compressed air.

c. Scrape all remaining gasket material and carbon from parts. Use care so as not to damage sealing surfaces.

d. Clean valves with a soft wire buffer to remove carbon. Ream carbon from valve guides.

4-8. Inspection

a. Examine valve and valve seats for pitting, burning, warping and other defects.

b. Examine valve springs for indications that the oil passages to the valve levers may be blocked causing wear on the valves and guides. Check for dry and rusted valve springs. Test each spring against the specifications (refer to table 1-4).

c. Check all valve lifter rods by rolling on a flat surface.

d. Examine cylinder head for signs of cracks or sand holes. Check the areas around exhaust valve ports for indications of blow-by. Check cylinder head for warpage (refer to table 1-4) for tolerances.

e. Examine rocker arm shaft expansion plugs. Check the shafts on a surface plate for signs of bending, also check for wear from rocker arms. Examine all rocker arm parts for wear.

4-9. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace all gaskets, seals, and unserviceable parts.

c. Valve faces may be ground provided adequate valve margin remains after grinding. Refer to table 1-4 for proper valve face angle. Replace worn or burned valves.

d. Replace weak, broken or distorted springs. Replace damaged or distorted spring retainers.

e. Replace worn or damaged valve seat rings.

f. If clearance between rocker arm bushing and shafts exceeds 0.004 inch, replace bushings.

g. Repair or replace cylinder head if machine surfaces are marred, damaged, or warped beyond limits shown in table 1-4.

4-10. Reassembly and Installation

Refer to figure 4-1 and reassemble and install head, rocker arm, and valves as follows:

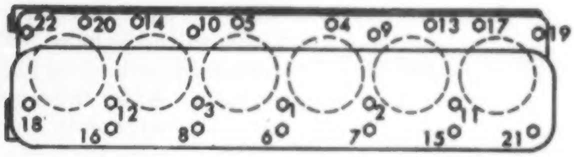
a. Chill valve seat rings (33 and 34) in dry ice for at least one-half hour before installation. Use an arbor press and driver to insert the rings into the cylinder head. An evenly applied 500 pound load is required for proper installation. Maintain 500 pound load for five seconds to assure proper seating.

Note. Do not install inserts by hammering or striking insert driver. After insert is installed do not peen the head metal over the edge of the insert. Replace with new valve seat rings.

b. Install valves (28 and 29) in cylinder head. Install lower spacers (25), inner spring (23), outer spring (24) and retainers (22 and 27). Compress springs and install locks (21 and 26). Install cup (20) on exhaust valve (29).

c. Install gasket (18) on engine. Install tappets (35). Using lifting eye (16), set cylinder head (17) in place. Install oil tube (19) in head.

d. Install pushrods (11) into the head, being certain that they enter the valve tappets and that each is in the same position as before. Install bolts (12 and 13) and washers (14) and hand tighten. Tighten all bolts to a torque of 100 foot-pounds according to the sequence shown in figure 4-2.



ME 3810-294-34/4-2

Figure 4-2. Crane engine head bolt tightening

e. Assemble rocker arm assembly, spring (44, fig. 4-1), expansion plugs (45), brackets (43), bushings (42), couplings (47), rocker arm (41), spring (38), washers (37), and retainers (36). Install adjusting screws (40) and nuts (39) on rocker arm.

f. Install bolts (5), nuts (6), and washers (7 and 8). Install oil bolt washer (15), gasket (10) and oil bolt (9). Tighten all bolts to a torque of 25 foot-pounds, except oil bolt (9) to 65 foot-pounds.

g. To adjust the valve stem to valve rocker arm clearance, each piston must be on the top dead-center on its compression stroke at the time of adjustment of valves for that cylinder. To determine the correct position, turn the engine crankshaft until No. 1 piston is at top dead-center on the compression stroke and the ignition timing mark on the flange of the fan drive pulley is in line with the pointer on the crankcase front cover.

h. Loosen the adjusting screw lock nut on both the No. 1 intake and exhaust valve levers, and adjust the clearance to 0.002 inch more than the hot clearance shown in table 1-4. Tighten the lock nut and recheck.

i. Crank the engine one-third revolution at a time and set the clearance of the valve for each cylinder. Do this on each set of cylinder valves in succession according to the firing order of the engine. The firing order is 1, 5, 3, 6, 2, 4.

j. Recheck the valve clearance with the engine at normal operating temperature and make final adjustments if necessary, from the cold adjustment just performed. Place gasket (4), cover (3) and secure with nut (1) and washer (2).

Section III. REPAIR OF GEAR COVER

4-11. Description

The gear cover provides access to the gear train, which provide a positive and accurate drive for the oil pump, governor, and distributor. The gears must be properly alined for accurate timing.

4-12. Removal

Refer to figure 4-3 and remove gear cover as follows:

KEY to fig. 4-3.

1. Crankshaft nut
2. Starting nut washer
3. Capscrew (6)
4. Lockwasher (6)
5. Key
6. Damper pulley
7. Nut (2)
8. Lockwasher (2)
9. Bolt (2)
10. Lock tab (2)
11. Engine front support
12. Engine support insulator
13. Nut
14. Lockwasher
15. Timing indicator
16. Stud
17. Capscrew (6)
18. Washer (4)
19. Stud (2)
20. Cover assembly
21. Gasket
22. Plate
23. Gasket
24. Oil seal (2)
25. Oil seal (2)
26. Bearing (2)
27. Throttle lever shaft

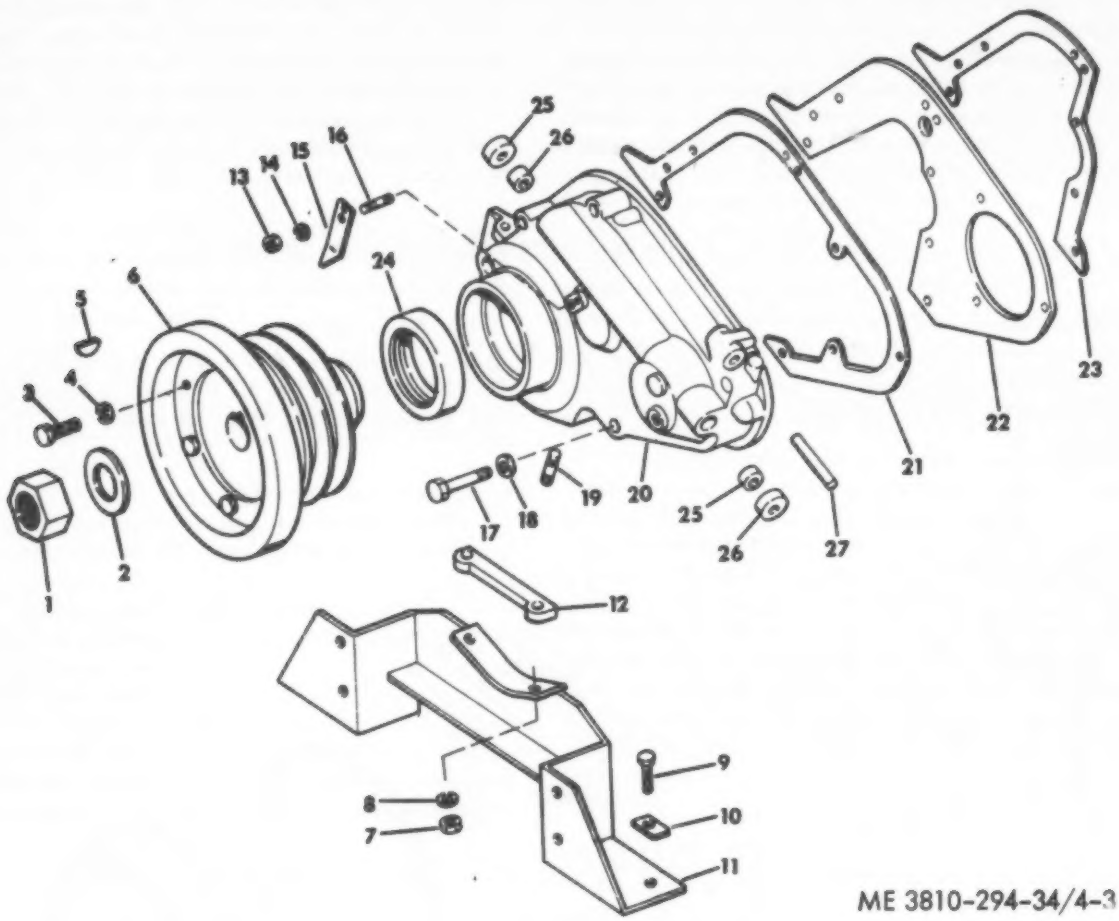


Figure 4-3. Gear cover, exploded view.

a. Remove crankshaft nut (1), washer (2), capscrews (3), and lockwashers (4).

b. Using a suitable puller, remove the crankshaft fan drive pulley (6) from the crankshaft. Remove key (5).

c. Remove nuts (7), washers (8), bolt (9), lock tab (10), and remove engine front support (11). Remove engine support insulator (12).

4-13. Disassembly

Refer to figure 4-3 and disassemble gear cover assembly as follows.

a. Remove nut (13), washer (14), timing indicator (15) and stud (16). Remove capscrews (17), washers (18) and stud (19).

b. Lift off cover assembly (20) and remove gasket (21), plate (22), and gasket (23).

c. Press oil seal (24) from front cover, and oil seals (25), bearing (26), and throttle lever shaft (27).

4-14. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Coat all machine surfaces with light oil to prevent rusting.

b. Scrape all remaining gasket material and carbon from parts. Use care so as not to damage sealing surface when scraping.

4-15. Inspection

Inspect cover for cracks and for damage. Examine all bearings for wear.

4-16. Repair and Replacement

Replace all gaskets, and refer to TM 5-3810-294-34P for repair parts.

4-17. Reassembly and Installation

Refer to figure 4-3 and reassemble and install gear cover as follows.

a. Install throttle lever shaft (27) in cover, bearings (26), and oil seal (25). Press oil seal (24) in cover.

b. Assemble gasket (23), plate (22), and gasket (21) on cover (20) and lift into place. Secure into place with capscrew (17) and washer (18). Install studs (19 and 16), and timing indicator (15). Secure timing indicator with nuts (13) and washer (14).

c. Install engine support insulator (12) on engine front support (11) and secure support with bolts (9) and lock tab (10). Secure gear cover to front support with nuts (7) and washer (8).

d. Install key (5), damper pulley (6), capscrew (3), and lockwasher (4). Secure with crankshaft nut (1) and washer (2).

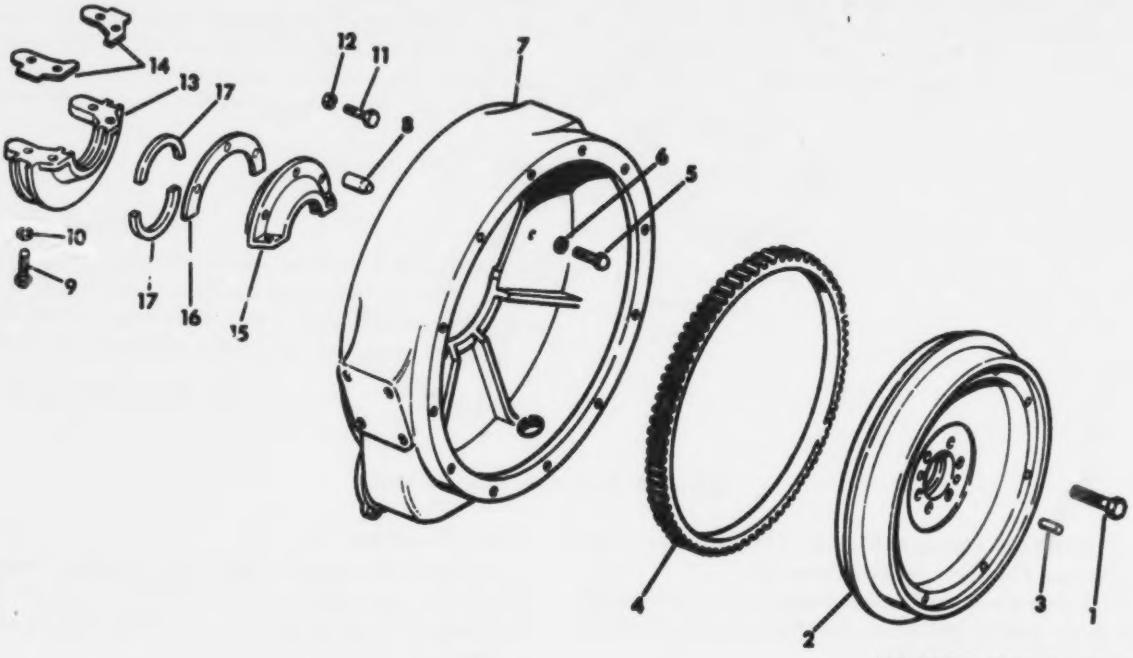
Section IV. REPAIR OF FLYWHEEL AND HOUSING

4-18. Description

The flywheel is attached to the rear of the crankshaft. Its purpose is to oppose and moderate by its inertia any fluctuations in the speed of the engine.

4-19. Removal

Refer to figure 4-4 and remove capscrew (1). With soft hammer, tap on the flywheel to loosen it from the crankshaft. Set flywheel aside.



ME 3810-294-34/4-4

1. Capscrew (6)
2. Flywheel
3. Dowel (2)
4. Ring gear
5. Capscrew (6)
6. Lockwasher (6)
7. Flywheel housing
8. Dowel (2)
9. Capscrew (2)
10. Lockwasher (2)
11. Capscrew (3)
12. Lockwasher (3)
13. Retainer
14. Gasket (2)
15. Retainer
16. Gasket
17. Felt seal (2)

Figure 4-4. Flywheel and housing, exploded view.

4-20. Disassembly

Refer to figure 4-4 and disassemble flywheel and housing assembly as follows.

a. Remove dowel (3) and press ring gear (4) from flywheel (2). The ring gear is a shrink fit and is replaceable.

b. Remove capscrews (5) and washers (6). Lift flywheel housing (7) from crankcase. Drive out dowel (8).

c. Remove capscrews (9), washers (10), capscrews (11), and washers (12), and lift out retainer (13). Remove gasket (14), retainer (15), gasket (16) and felt seal (17).

4-21. Cleaning

Clean all parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Coat all machine surfaces with light oil to prevent rusting.

4-22. Inspection

Inspect flywheel and ring gear for wear and damage. Inspect flywheel housing for cracks or breakage. Inspect all dowels and dowel holes for wear.

4-23. Repair and Replacement

Replace all gaskets and refer to TM 5-3810-294-34P for repair parts.

4-24. Reassembly and Installation

Refer to figure 4-4 and reassemble and install flywheel and flywheel housing as follows.

a. Install upper retainer (15), gasket (14), and lower retainer (13). Set gasket (16) into place and install felt seal (17). Secure with capscrews (9) and (11) and lockwashers (10) and (12).

b. Install ring gear (4) on flywheel (2) by heating the gear and then placing it on the flywheel while the ring gear is hot. The chamfered edge of the ring gear is placed on the flywheel first so that, when assembled; the edge faces away from the engine.

c. Place the flywheel housing over the two flywheel housing to crankcase dowels (8) and tap into place with a soft hammer.

d. Install bolts (5) and washers (6) and secure the housing to a torque of 80 foot pounds.

e. Check the concentricity of the housing bore and the crankshaft face for proper tolerances and run out. Refer to table 1-4 for run out tolerances. If the concentricity is not within tolerances, remove the housing and proceed below.

f. Remove dowels (8) from crankcase. Loosen bolts (5), and do not tighten these bolts to full torque. Just run the bolts down snug.

g. Position the housing to meet the tolerances given in table 1-4. Tighten all bolts to full torque. Recheck the flange tolerances and reposition the housing if necessary. Ream the dowel holes for oversize dowels and install oversize dowels.

h. Lubricate the pilot bearing and place the flywheel and ring gear assembly into position on dowels (3). Install capscrew (1) and torque to 150 foot-pounds.

Section V. REPAIR OF OIL PAN AND OIL PUMP

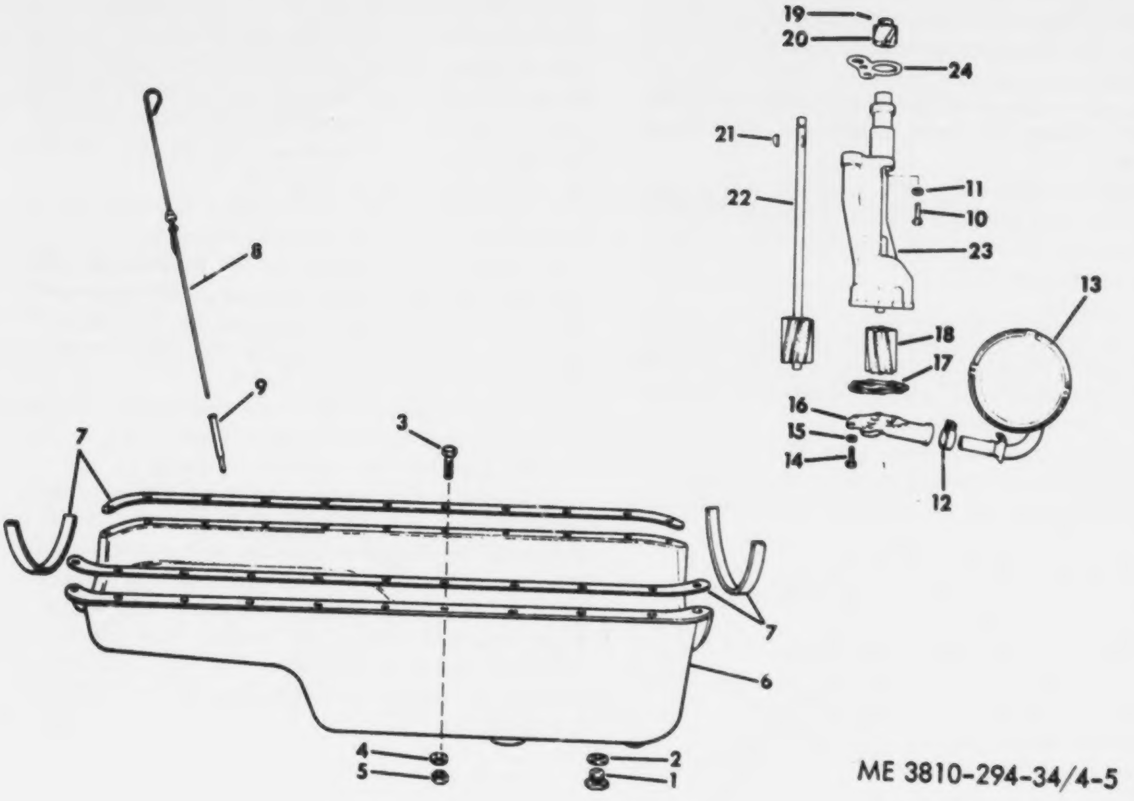
4-25. Description

The oil pan is self-explanatory. The oil pump delivers pressurized oil through rifle-drilled passages in the crankcase to the main bearings, cam shaft bearings; timing gears, governor, valve lever assembly and the oil filter.

4-26. Removal

Refer to figure 4-5 and remove oil pan and oil pump as follows.

best copy available



1. Plug
2. Gasket
3. Capscrew (20)
4. Lockwasher (22)
5. Nut (12)
6. Pan
7. Gasket set
8. Dipstick
9. Tube
10. Capscrew (2)
11. Washer (2)
12. Cotter pin
13. Screen
14. Capscrew (6)
15. Lockwasher (6)
16. Cover
17. Gasket
18. Gear
19. Pin
20. Drive gear
21. Key
22. Shaft
23. Body
24. Gasket

Figure 4-5. Oil pan and oil pump, exploded view.

a. Remove plug (1) and gasket (2). Remove capscrews (3), nuts (5), and washer (4). Lower pan (6).

b. Remove gasket (7), dipstick (8) and tube (9).

Note. It is necessary to have the oil pump correctly timed with the camshaft. Correct timing is necessary because the pump drive gear also drives the distributor. Before removing oil pump from the engine, mark the position of the pump shaft so that the pump can be readily replaced in the correct timing. Crank the engine over until the No. 1 piston is on top dead-center of compression stroke, then punch mark the lower end of the pump shaft and the pump cover so that the shaft can be again set in the same position.

c. Remove capscrews (10) and washers (11), and remove pump from engine.

4-27. Disassembly

Refer to figure 4-5 and disassemble oil pump as follows:

a. Remove cotter pin (12) and remove screen and float (13).

b. Remove capscrews (14), lockwashers (15), and cover (16). Remove gasket (17).

c. With the pump cover removed and the gears and shaft in place, exert pressure against the gears with the thumb so as to push the gears away from the outlet side of the pump. Measure the clearance between outside diameter of gear and bore of housing. Clearance should be within the limits given in table 1-4. Check backlash between pump body gears and replace gears if backlash exceeds the figure shown in table 1-4.

d. Lift oil pump idler gear (18) from the idler gear shaft. Support the oil pump shaft to prevent bending, and drive pin (19) from the gear. Press gear (20) from shaft. Remove key (21) from shaft (22). Remove shaft (22) from pump body (23).

4-28. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air.

b. Remove all remaining gasket material from parts.

4-29. Inspection

a. Inspect all gears for wear and chipped teeth.

b. Inspect the body and oil pump cover for evidence of wear (gear contact) for damage.

4-30. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace all damaged gears.

c. Refer to the inspection made during disassembly (para 4-27 step c) in determining the gear to body clearance and gear backlash. Replace necessary parts if this inspection reveals variations from the values shown in table 1-4.

4-31. Reassembly and Installation

Refer to figure 4-5 and reassemble and install oil pump and oil pan as follows.

a. Lubricate all pump gears and shaft with engine oil for initial lubrication.

b. Install shaft (22) in pump body (23), and install idler gear (18).

c. Check the clearance between the outside diameter of the gear and the bore of the housing as was done during disassembly. Check the pump shaft clearance in the bore of the body and the backlash between the pump body gears against values given in table 1-4.

d. Assemble gasket (17) and cover (16), and check the body gear end clearance. The pump cover gaskets control the end play between the gears and the pump cover. Add or remove gaskets to obtain the proper clearance shown in table 1-4.

e. Install key (21) in shaft (22). Press gear (20) into place on shaft (22) and secure gear to the shaft with pin (19). Install gasket(17), cover (16) and install washers (15) and capscrews (14).

Note. Remove the distributor before attempting to install the oil pump.

f. Place gasket (24) on pump housing and insert the oil pump into the block so that the slot at the top of the oil pump shaft is at a 30 degree angle to the side of the engine when the No. 1 piston is at top dead-center of the compression stroke. Secure the pump to the engine block with capscrews (10) and washers (11).

g. Position the oil pump float on the oil pump, line up the pin holes, and insert a new cotter pin (12).

h. Position gaskets (7) on pan (6), and position oil pan assembly on the engine. Secure with capscrews (3), nuts (5) and washers (4). Torque capscrews to 25 foot-pounds.

i. Install tube (9), dipstick (8), gasket (2) and plug (1).

Section VI. REPAIR OF CAMSHAFT, CRANKSHAFT, PISTONS AND RODS

4-32. Description

a. The crankshaft supports the connecting rod and pistons along its length. At the forward end is the crankshaft gear which drives the camshaft. The crankshaft is a drop forging of heat treated steel. It is counterweighted, dynamically balanced, and ground to close limits.

b. The camshaft is located in the crankcase on the left side of engine, and is held to the crankcase by a thrust plate. The camshaft is supported at intervals along its length by four bushings. These bushings are press-fit in the crankcase and are removable. The camshaft operates the intake and the exhaust valve mechanism by action of its lobes upon the pushrods during rotation. Camshaft bearings are pressure lubricated by oil holes drilled in the bearings. Oil holes in the bushings must aline with the holes drilled in the crankcase.

c. The rods serve as links between the pistons and the crank throw.

4-33. Removal

Refer to figure 4-6 and remove camshaft as follows.

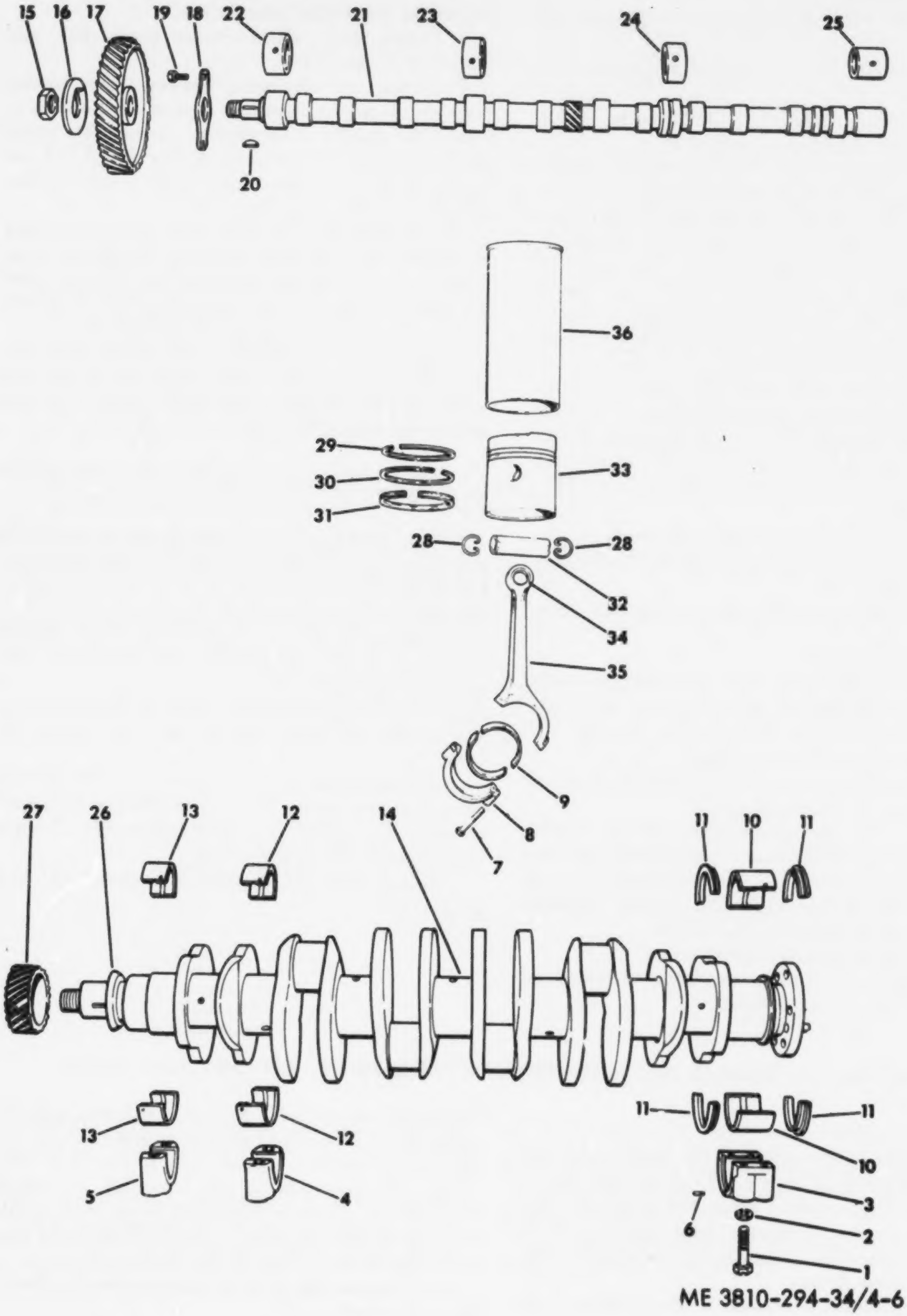

15
16
17
19
18
22
21
23
24
25
20
36
29
30
31
33
28
28
32
34
35
9
8
7
27
26
13
12
14
11
10
11
11
11
13
12
10
5
4
3
6
2
1
ME 3810-294-34/4-6

Figure 4-6. Camshaft, crankshaft, piston and rod, exploded view.

KEY to fig. 4-6.
1. Bolt (16)
2. Washer (16).
3. Rear bearing cap
4. Intermediate bearing caps (5)
5. Front bearing cap
6. Pins (2)
7. Rod cap bolt (12)
8. Cap (6)
9. Connecting rod bearing (6)
10. Rear crankshaft bearing
11. Thrust washer (2)
12. Intermediate crankshaft bearing (5)
13. Front crankshaft bearing
14. Crankshaft
15. Camshaft gear nut
16. Retainer
17. Camshaft gear
18. Thrust flange
19. Capscrew (2)
20. Key
21. Camshaft
22. Front bearing
23. Second bearing
24. Third bearing
25. Rear bearing
26. Oil slinger
27. Gear
28. Retaining ring (12)
29. Compression ring (6)
30. Intermediate ring (6)
31. Oil ring (6)
32. Piston pin (6)
33. Piston
34. Piston pin bushing (6)
35. Connecting rod (6)
36. Piston sleeve (6)

a. Remove valve mechanism and valve push rods, side cover and gaskets, tappets, oil pan, oil pump, water pump, and gear cover as discussed previously.

b. Rotate the camshaft gear until capscrews (19) can be removed through the holes in the gear.

c. Remove the camshaft (21) from the crankcase.

d. Remove the flywheel and housing as described in paragraph 4-19. Remove cap bolts (1), washers (2), rear bearing cap (3), intermediate bearing caps (4), front bearing cap (5), and pins (6). Remove rod cap bolts (7), caps (8), and bearings (9). Push piston and connecting rod assemblies to top of sleeve bore.

e. Twist crankshaft out of the crankcase. Remove main bearing halves (10, 12, 13), and thrust washer (11) from the crankcase.

4-34. Disassembly

Refer to figure 4-6 and disassemble as follows.

a. Remove camshaft gear nut (15) and retainer (16) holding the gear on the camshaft.

b. Using a gear puller, remove gear (17) from the shaft and remove thrust plate (18). Remove key (20).

c. Camshaft bearing (22, 23, 24, and 25) may be removed if necessary using an end shaft bushing tool.

d. Remove oil slinger (26) and with a suitable puller remove gear (27) from crankshaft (14).

e. Mark each rod for replacement in the same position.

Note. Using a ridge reamer remove the ridge on the cylinder wall at the upper end of the ring travel. This prevents damage to the piston ring land during removal of the pistons.

f. Push rod and piston assembly to the top and lift out of the crankcase.

g. Remove retaining rings (28) and, using a piston ring expander, remove piston rings (29, 30, and 31), in that order.

h. Heat the piston in boiling water or a piston heater, and drive piston pin (32) from piston (33). Remove piston pin bushing (34) from rod (35).

i. Using a sleeve puller, remove sleeves (36).

4-35. Cleaning

a. Clean all parts in a dry cleaning solvent. Clean carbon from the piston ring grooves with a broken ring or a ring groove cleaner.

b. Coat each part with clean engine oil to prevent rusting.

4-36. Inspection

a. Inspect camshaft journal for wear. Compare the dimensions of the camshaft as listed in table 1-4. Examine bearing surfaces for signs of wear or out of round.

b. Inspect the camshaft lobes for evidence of chipping. Compare lifting areas of the cam lobes with table 1-4. If the amount of wear exceeds 0.002 inch, the camshaft should be replaced.

c. Inspect timing gear for wear or damage. Examine thrust flange for wear. Inspect oil pump drive gear.

d. Inspect camshaft bearings and determine running clearance. Compare dimensions with those shown in table 1-4.

e. Inspect crankshaft bearing for wear and evidence of uneven bearing support. If such evidence is present, examine the bearing caps and the crankcase for high spots and burrs.

f. Inspect crankshaft journals and measure the diameter of each journal using a micrometer. Measure each journal at two points, one at right angles to the other, to show any tendency of out of round. Move the micrometer over the entire width of the journal. Compare dimensions with hose shown in table 1-4.

g. Inspect rods, caps, bearing shells, and pin bushings. All rod bearings and piston pin bushings should be replaced at every major overhaul.

h. Aline connecting rods using a connecting rod mandril. Lay the rods flat in the mandril and check for twisting malformation by inserting feeder gages between the rod and mandril. Malformation of 0.004 inch or greater is cause for rejecting the rod.

i. Inspect the pistons for cracks, breaks, or scores. Check piston ring grooves and piston ring lands for wear using a new piston ring and feeler gage.

j. Inspect piston pin for wear and sign of etching.

k. Inspect all bushings for burrs and mars, dress off any such unevenness.

l. Measure the piston skirt at right angles to the pin holes to determine if it is worn.

m. Check cylinder bore with inside-reading micrometer to determine taper, out of round, or worn condition.

n. Inspect piston rings for damage.

4-37. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace camshaft if bearings are worn, lobes are worn or cracked, or gear teeth are cracked, broken, or worn. Replace comshaft gear if teeth are cracked, broken, or worn.

c. Remove nicks and marks from bearings and bearing surfaces. Replace worn or defective bearings.

d. Replace twisted or distorted rods.

e. Replace pistons if cracked, or if ring grooves are damaged. Replace piston pins if mutilated or worn. Replace cracked or damaged piston rings.

f. Replace all capscrews that have been damaged or show evidence of mutilated threads or distortion.

4-38. Reassembly and Installation

Refer to figure 4-6 and reassemble and install as follows.

a. Install sleeves (36).

b. Install piston pin bushing (34) in rod (35). Heat piston in hot water to approximately 150 degrees F, and push piston pin through piston and rod bushing, alining the bushing and rod bore with piston pin holes in the piston, and push the piston pin (32) completely into position through rod (35). Install retainer (28).

c. Install rings (31, 30 and 29) into piston grooves using a piston ring expander. Position the rings so that the gaps are 90 degrees from the thrust side of the piston (in line with the piston pin bore) and 180 degrees from one gap to another.

d. Coat piston, piston ring compressor and sleeve with oil. Install piston and rod assembly through top of crankcase.

e. Replace bearing shell halves (11, 12, and 13), and thrust washer (11), in the bore of the crankcase and bearing caps. Be sure the shells are fully seated, oil holes are alined, and the locking tangs on the bearings fit into the recesses. Apply a film of engine oil on the bearing shells and place the crankshaft into position.

Note. Index the timing marks on the crankshaft gear and camshaft gear.

f. Install bearing caps (3, 4, and 5) over the crankshaft journals being sure that the caps are in their correct positions with the number side of the caps to the camshaft side of the engine. Secure lightly with washers (2) and bolts (1).

g. Install rod bearings (9), caps (8), and rod cap bolt (7).

Note. Be sure rod cap bolt threads are in good condition. Be sure blind holes in rod (36) are clean of chips and dirt. Refer to table 1-4 for rod side clearance. Torque bolts to 80 foot-pounds.

h. Place camshaft plate (18) on camshaft and install camshaft gear key (20). Heat the camshaft gear in boiling water and install the gear (17) (with the timing mark facing away from the shaft) on the camshaft.

i. Install camshaft bearings (22, 23, 24, and 25) using camshaft bushing tool.

j. Coat the camshaft and lobes with heavy duty axle lubricant. Install the camshaft into the crankcase being sure that the timing mark on the camshaft gear is correctly indexed with the timing mark on the crankshaft gear. Secure thrust plate to crankcase with capscrews (19). Check camshaft and play and gear backlash against values given in table 1-4.

k. Install retainer (16) and secure with nut (15).

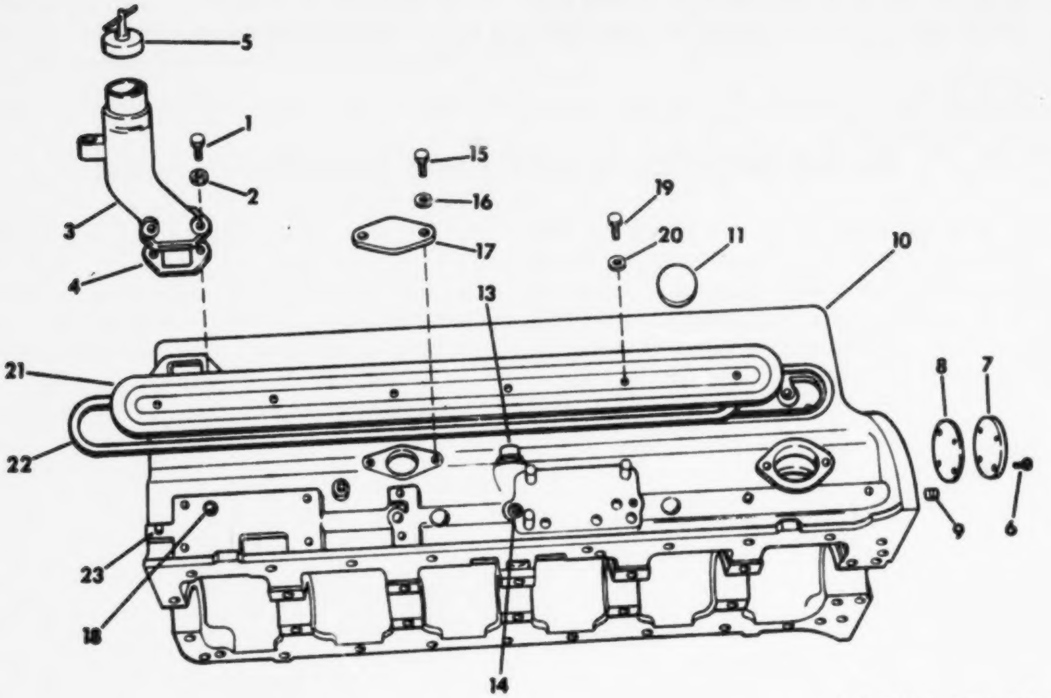
Section VII. REPAIR OF ENGINE CRANKCASE

4-39. Description

The crankcase supports the crankshaft in true alinement, and provides the housing for the pistons and driving components.

4-40. Disassembly

Refer to figure 4-7 and disassemble crankcase as follows.



ME 3810-294-34/4-7

1. Capscrew (2)
2. Lockwasher (2)
3. Oil filler
4. Gasket
5. Cap
6. Capscrew (4)
7. Camshaft cover
8. Gasket
9. Plug
10. Crankcase
11. Expansion plug
12. Plug
13. Distributor tube
14. Plug
15. Capscrew (2)
16. Lockwasher (2)
17. Cover
18. Plug
19. Capscrew (6)
20. Washer (6)
21. Valve lifter cover
22. Gasket
23. Plug

Figure 4-7. Crankcase, exploded view.

a. Remove capscrew (1), washers (2), and lift off oil filter (3) and gasket (4). Remove cap (5).

b. Remove capscrew (6), camshaft cover (7), gasket (8), and plug (9) from crankcase (10).

c. Remove expansion plug (11), plug (12), distributor tube (13) and plug (14).

d. Remove capscrew (15), lockwasher (16) and cover (17). Remove plug (18).

e. Remove capscrews (19), washers (20) and lift off valve lifter cover (21) and gasket (22). Remove plug (23).

4-41. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S 661) and dry thoroughly with compressed air.

b. Clean bearings carefully in solvent and allow to dry. Do not use compressed air to dry bearings. Soak bearings in oil immediately after drying and wrap in wax paper or other waterproof material.

c. Clean all oil holes and passages with brass probe to remove deposits.

4-42. Inspection

a. Inspect all bearings for pits, wear, or score marks.

b. Check crankcase casting for cracks for other visible damage.

4-43. Repair and Replacement

Refer to figure 4-7 and reassemble and install as follows.

a. Install gasket (22) and cover (21) and secure with capscrew (19) and washer (20).

b. Install plug (18). Install cover (17) and secure with capscrew (15) and washers (16). Install plug (14), distributor tube (13), plug (12), and plug (11).

c. Install plug (9). Install camshaft cover gasket (8) and cover (7) and secure with capscrew (6).

d. Install gasket (4) and oil filter (3), and secure with capscrew (1) and lockwasher (2).

CHAPTER 5

REPAIR OF CRANE DRIVE TRAIN

Section I. REPAIR OF CRANE TRANSMISSION AND CLUTCH

5-1. Description

The crane transmission and clutch are treated as a single assembly, since they must be removed with the engine as a complete unit. The clutch is an 11½ inch over-center type consisting of a solid heavy duty asbestos covered plate of unitized construction and spring-loaded solid steel backing plates. Minimum clutch capacity is 435 foot-pounds. The transmission is a single speed, speed reduction type. Transmission reduction ratio is 2.49:1. The interrelationship of the transmission / clutch assembly to other drive train components is shown in figure 5-1.

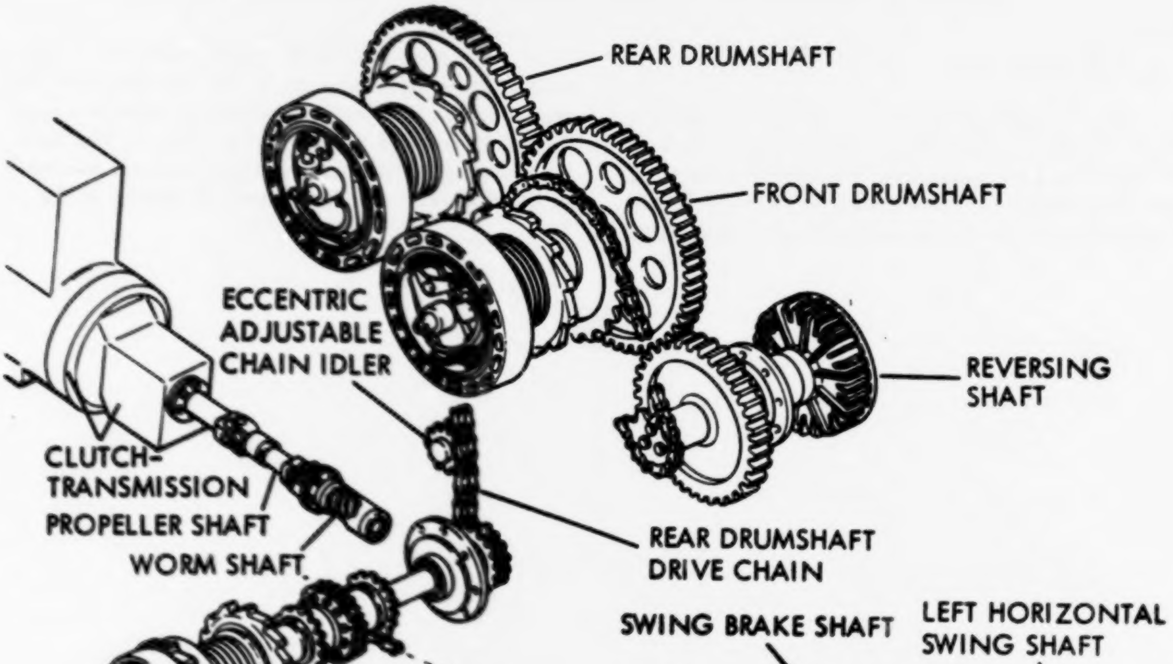

REAR DRUMSHAFT
FRONT DRUMSHAFT
ECCENTRIC ADJUSTABLE CHAIN IDLER
REVERSING SHAFT
CLUTCH-TRANSMISSION PROPELLER SHAFT
WORM SHAFT
REAR DRUMSHAFT DRIVE CHAIN
SWING BRAKE SHAFT
LEFT HORIZONTAL SWING SHAFT
CHAIN
BOOM HOIST SHAFT
ADJUSTABLE HORIZONTAL SWING SHAFT IDLER CHAIN SPROCKETS
RIGHT HORIZONTAL SWING SHAFT
VERTICAL SWING SHAFT
ME 3810-288-35/5-1

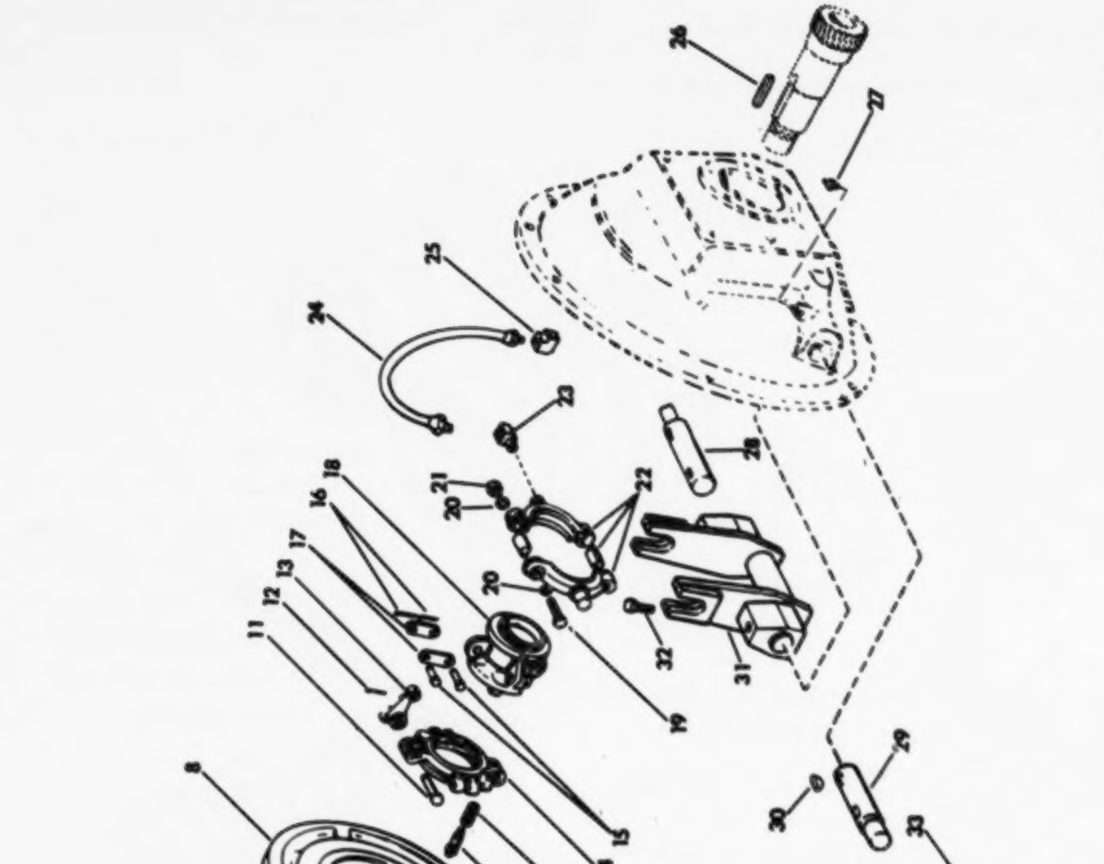
Figure 5-1. Inter-relationship of crane drive train major components.

5-2. Removal of Transmission/Clutch Assembly

a. Refer to figure 5-2 and remove items (33 through 40).

b. Refer to paragraph 2-13 and remove engine, clutch, and transmission from the crane as a unit.

c. Refer to paragraph 2-14 and remove transmission/clutch from the engine. Place the assembly on a suitable stand for disassembly and repair.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41

ME 3810-288-35/5-2

Figure 5-2. Engine clutch assembly exploded view.

KEY to fig. 5-2.

1. Bearing
2. Driving ring
3. Nut
4. Tab washer
5. Plate
6. Spring (6)
7. Driving plate
8. Floating plate
9. Lock pin
10. Spring
11. Finger pin (2)
12. Cotter pin
13. Finger lever
14. Adjusting yoke
15. Link lever pin (2)
16. Cotter pin (2)
17. Lever link (2)
18. Sliding sleeve
19. Capscrew (2)
20. Lockwasher (2)
21. Nut (2)
22. Collar assembly
23. Elbow
24. Tube
25. Elbow
26. Key
27. Lubrication fitting
28. Shaft
29. Shaft
30. Key (2)
31. Lever (2)
32. Capscrew (2)
33. Capscrew
34. Clutch rod support
35. Clutch rod
36. Flat washer
37. Cotter pin
38. Nut
39. Lockwasher
40. Lever
41. Capscrew (6)

5-3. Clutch Disassembly

Refer to figure 5-2 and disassemble clutch as follows:

a. Remove nut (3) and tab washer (4). Discard washer (4).

b. Disconnect lubrication hose (24) from behind clutch plates (5, 7, and 8).

c. Pull clutch plates and springs (5, 6, 7, and 8) from transmission input shaft (shown in phantom on the illustration). Be sure key (26) does not damage clutch parts mounted at the rear of plate (8). The entire clutch assembly, with the exception of parts (28 through 32) come off the transmission input shaft with the clutch plates.

d. Pull lock pin (9) and lock it in the out position by inserting a small pin in the cross-drilled hole. Turn entire assembly, consisting of items (9 through 23), in a counterclockwise direction to unscrew adjusting yoke (14) from plate (5).

e. Remove plate (8), driving plate (7), springs (6), and plate (5) from the assembly.

f. Remove pin from lock pin (9) and remove pin (9) and spring (10).

g. Remove cotter pins (16), pins (15), and lever links (17). Discard cotter pins.

h. Remove items (19, 20, and 21) and remove collar assembly (22).

i. If necessary, loosen capscrews (32) and remove shafts (28) and (29). Then remove lever (31).

j. Bearing (1) is a loose fit and can be removed from the flywheel bore.

5-4. Clutch Inspection and Repair

a. Clean all metal parts with a suitable solvent.

b. Inspect clutch driving plate (7, fig. 5-2) for signs of excessive lining wear. If a rivet is within 1/16 inch of the surface of the asbestos lining surface, replace lining or the plate.

c. Inspect all threaded items and replace any item with damaged threads.

d. Replace all cotter pins and tab washers.

e. Inspect grease fittings for wear and replace any damaged item.

f. Inspect all parts for wear, scoring, cracks, or other signs of damage and replace any part in doubtful condition.

5-5. Clutch Reassembly

Refer to figure 5-2 and reassemble the clutch as follows:

a. Install bearing (1) in the bore provided in the engine flywheel.

b. Install driving ring (2) and secure it in position with capscrews (41), if it was removed.

c. Install clutch shafts (28 and 29) part way into the bell housing and place lever (31) between them. Push both clutch shafts fully in and secure in position with capscrews (32).

d. Install clutch lever (40) and secure lever in position with capscrew (33). Tighten capscrew (33) to 85 foot-pounds.

e. Subassemble clutch plates (5, 7, and 8) with springs (6) in position as shown. Plate (5) should be facing upward on the bench, with threaded hub up.

f. Slip pin (9) through spring (10) and insert pin (9) into clutch yoke (14) in the direction shown. Press pin inward, against spring (10) pressure, and place a pin or nail through the cross-drilled hole in the adjusting pin to hold adjusting pin out of engagement with plate (8). Install finger levers (13) on yoke (14) with pins (11) and cotter pins (12).

g. Screw yoke (14) on the hub of clutch plate (5). Turn yoke approximately five turns.

h. Assemble sliding sleeve (18) onto levers (13), housing pins (15), cotter pins (16), and lever links (17).

i. Install collar assembly (22) over the flange on end of sliding sleeve (18) and secure in position with capscrews (19), washers (20), and nuts (21). Install grease fitting (23).

j. Install entire subassembled clutch on the end of the transmission input shaft, making sure keyway lines up with key (26), and install key (26). Be sure the knobs on collar (22) fit into lever (31) slots. Connect hose (24). Install tab washer (4) and secure the entire assembly in position with nut (3).

5-6. Transmission Disassembly

a. Disassemble clutch as instructed in paragraph 5-3.

b. Place the transmission assembly on the bench and block it so it cannot move. Refer to figure 5-3 during transmission disassembly. An assembled view of the transmission / clutch assembly is shown in figure 5-4 for an additional reference.

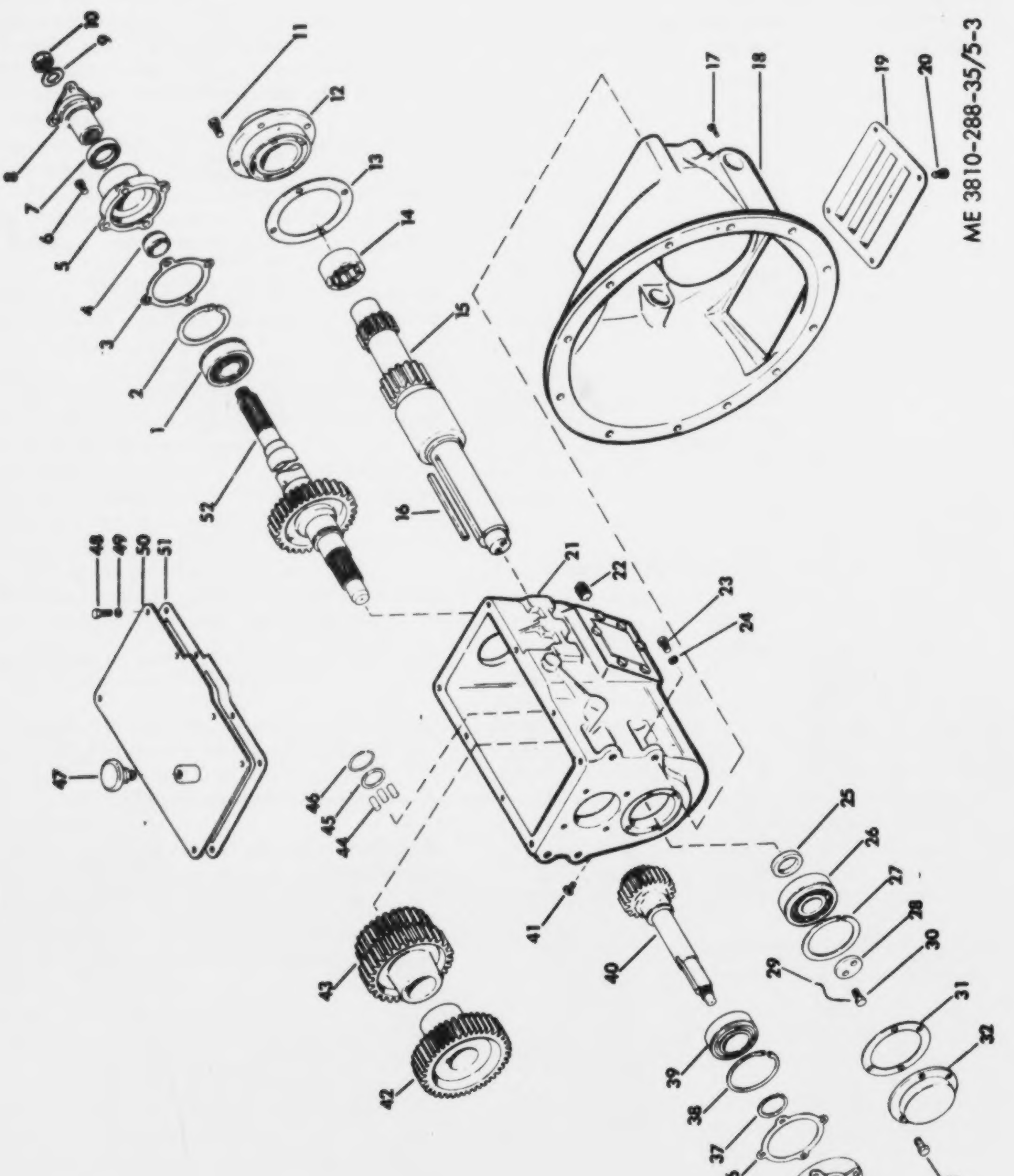

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
ME 3810-288-35/5-3

Figure 5-3. Transmission assembly exploded view.

KEY to fig. 5-3.

1. Bearing
2. Retaining ring
3. Gasket
4. Spacer
5. Bearing retainer
6. Capscrew
7. Seal
8. Companion flange
9. Washer
10. Nut
11. Capscrew
12. Bearing retainer
13. Gasket
14. Bearing
15. Counter shaft
16. Key
17. Capscrew
18. Clutch housing
19. Cover
20. Capscrew
21. Housing
22. Drain plug
23. Capscrew (4)
24. Lockwasher (4)
25. Thrust washer
26. Bearing
27. Retaining ring
28. Retaining washer
29. Lockwire
30. Capscrew (2)
31. Gasket
32. Bearing retainer
33. Capscrew (4)
34. Capscrew (4)
35. Gear retainer
36. Gasket
37. Retaining ring
38. Retaining ring
39. Bearing
40. Input shaft
41. Level plug
42. Pinion gear
43. Pinion gear
44. Needle bearing (12)
45. Retaining washer
46. Retaining ring
47. Breather
48. Capscrew (8)
49. Lockwasher (8)
50. Cover
51. Gasket
52. Shaft

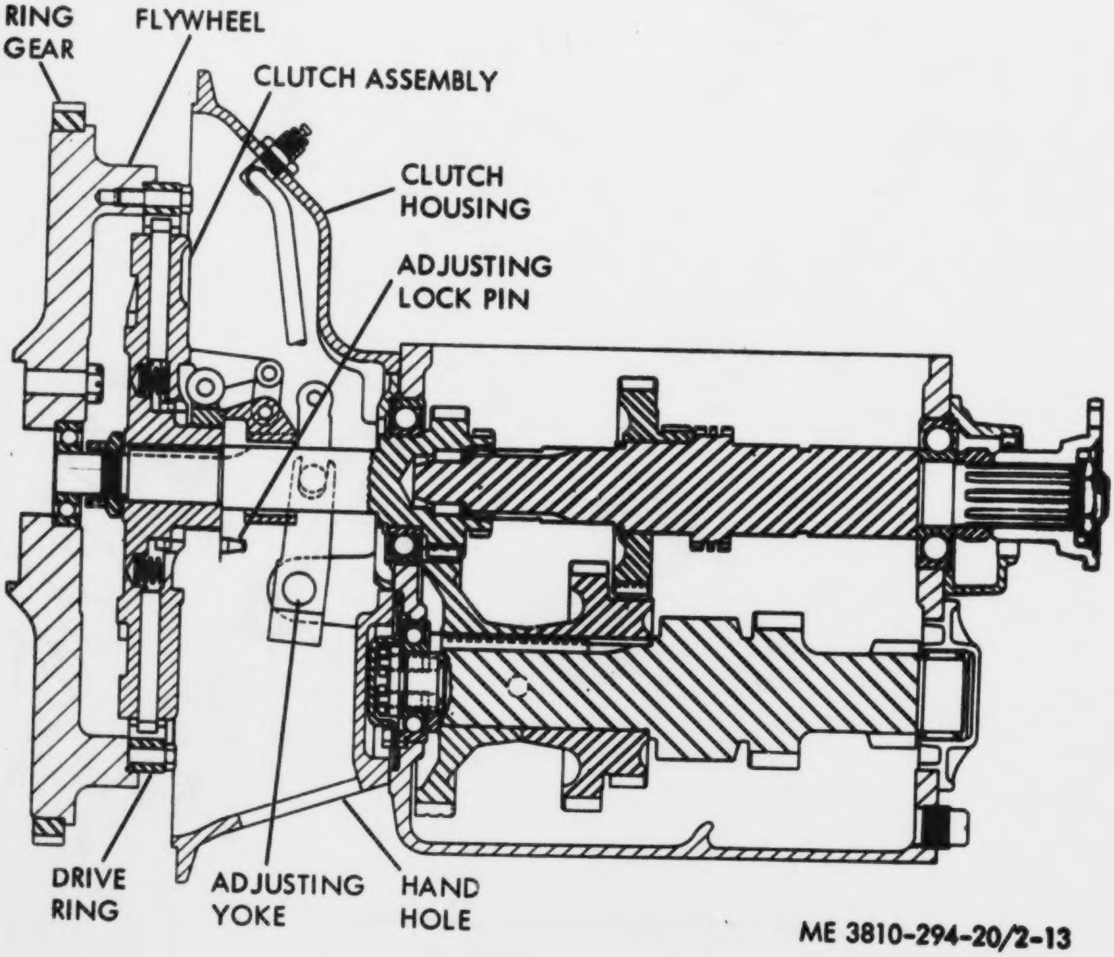

RING GEAR
FLYWHEEL
CLUTCH ASSEMBLY
CLUTCH HOUSING
ADJUSTING LOCK PIN
DRIVE RING
ADJUSTING YOKE
HAND HOLE
ME 3810-294-20/2-13

Figure 5-4. Transmission / clutch assembled view.

c. Remove capscrews (48, fig. 5-3), lockwashers (49), cover (50), gasket (51), and breather (47). Remove clutch housing (18) by removing capscrews (23) and lockwasher (24).

d. Remove retainer (35) by removing capscrews (34). Remove gasket (36) and retaining rings (37 and 38). Discard items (36, 37, and 38).

e. Remove nut (10) and washer (9). Remove companion flange (8).

f. Remove retainer (5) by removing capscrews with lockwashers (6). Remove spacer (4). Remove oil seal (7) from retainer (5) and discard the seal. Replace with new seal. Be sure seal lip points inward. Remove and discard gasket (3). Remove retaining ring (2).

g. Pull out on input shaft (40) while tapping housing (21) with a soft hammer. Remove bearing (39) with suitable puller.

h. Support front end of shaft (52) while tapping it rearward with a soft hammer until shaft bearing (1) is unseated from housing (21). Remove bearing (1) with suitable puller.

i. Tilt shaft (52) upward and remove it.

j. Remove retainer (32) by removing capscrews (33). Remove and discard gasket (31).

k. Break lockwire (29) and remove retaining washer (28) by removing capscrews (30).

l. Remove bearing retainer (12) by removing capscrews (11). Remove and discard gasket (13).

Note. Tapping the front end of shaft (15) with a soft hammer will aid the removal of retainer (12).

m. Support the rear end of shaft (15) and tap the rear of the shaft gently with a soft hammer until bearing (26) can be removed. Discard items (27 and 26). Tip shaft (15) upward and remove it. Remove spacer (25).

n. Place shaft (15) in a suitable press with blocks supporting the rear of gear (43) and press out shaft (15). Remove key (16).

5-7. Transmission Inspection and Repair

a. Clean all parts with a suitable solvent.

b. Discard all bearings, replace all gaskets, seals, snap rings, and lockwire.

c. Since clearances and tolerances in this assembly are maintained by parts of proper fit rather than by adjustments or shimming, it is most important that any severely worn parts be discarded.

d. Inspect gears for wear or pitting on tooth faces. All gears with worn or pitted teeth should be replaced. Check all engaging gear teeth. Check all splines for wear or damage.

e. Inspect all grey iron parts for cracks and fractures. Replace or repair all damaged parts. Housing may be welded or brazed if cracks do not extend into bearing bores or mounting surfaces.

5-8. Transmission Reassembly

Refer to figure 5-3 and reassemble the transmission as follows:

a. Subassemble key (16), pinion gears (42 and 43) and spacer (25) on shaft (15). Always lubricate all transmission parts with OE before installing them.

b. Lay shaft (15) in bottom of housing (21). Be sure spacer (25) is still in place on front of shaft (15). Start bearing (26) into lower front bearing bore, and start shaft (15) into bearing (26).

c. Install needle bearing (14), gasket (13), retainer (12), and secure in position with capscrews (11). Tighten capscrews (11) to 20-40 foot-pounds.

d. Install retaining ring (27), and retaining washer (28). Tighten capscrews (30) to 12-22 foot-pounds, and install lockwire (29) in capscrews (30).

e. Install gasket (31) and retainer (32), and secure with capscrews (33). Tighten the capscrews to 15-25 foot-pounds.

f. Lower shaft (52) into housing (21). Center the rear of shaft (52) in the rear bearing bore and drive bearing (1) onto shaft (52) until it is squarely seated in the bore.

g. Install retaining ring (2) on bearing (1). Install spacer (4), gasket (3), retainer (5), and secure with capscrews (6). Tighten the capscrews to 20-40 foot-pounds.

h. Warm and install bearing (39) on shaft (40). Install retaining rings (37 and 38). Using heavy grease to hold in place, install needle bearings (44) in shaft (40) bore. Install retaining washer (45) and retaining ring (46). Start bearing (39) into the upper front bearing bore. Be sure that the front of shaft (53) enters the pilot bore of shaft (40). Gently tap shaft (40) with a soft hammer until retainer ring (38) is seated squarely on housing (21).

i. Install gasket (36), retainer (35), and secure with nut (10). Tighten the capscrews to 15-25 foot-pounds.

j. Install companion flange (8), washer (9) and secure with nut (10). Tighten the nut to 125 foot-pounds.

Note. Hold gear (47) in stationary position with brass pinch bar while tightening nut (10).

k. Install clutch housing (18) and secure with capscrews (23) and lockwashers (24). Tighten the capscrews to 70-110 foot-pounds. Install gasket (51), cover (50), and breather (47) and secure with capscrews (48) and washers (49).

l. Place clutch plate on the end of shaft (40) and turn the transmission gearing and shaft over to be sure the transmission turns smoothly.

m. Install the clutch assembly as instructed in paragraph 5-2.

n. Refer to paragraph 5-2 and install the clutch / transmission assembly on the engine.

o. Refer to figure 2-3 and install the engine-clutch / transmission assembly in the crane upper.

p. Refer to TM 5-3810-294-20 and adjust the engine clutch before returning machine to operation.

q. Refill the transmission with proper lubricant as instructed in TM 5-3810-294-20. Lubricate the clutch and the engine.

Section II. REPAIR OF CRANE PROPELLER SHAFT

5-9. Description

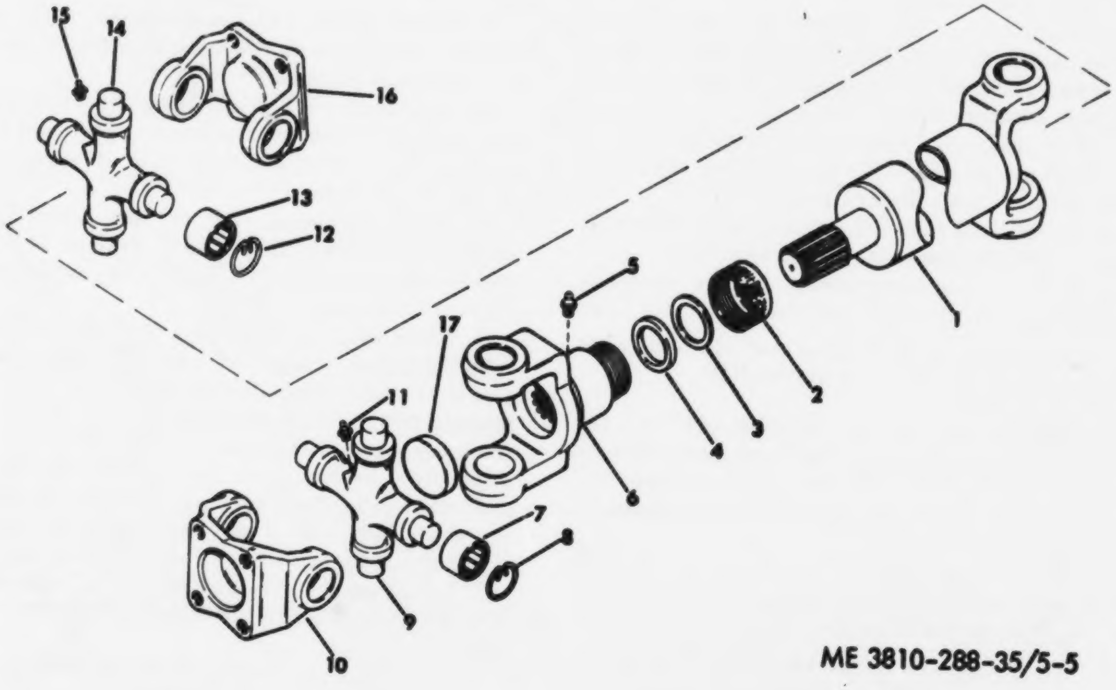
The propeller shaft connects the transmission output shaft to the warm shaft (refer to fig. 5-1).

5-10. Removal

Refer to TM 5-3810-294-20 and remove the propeller shaft.

5-11. Disassembly

Refer to figure 5-5 and disassemble the propeller shaft.



ME 3810-288-35/5-5

1. Shaft
2. Dust cap
3. Washer
4. Cork washer
5. Lubrication fitting
6. Sleeve yoke
7. Roller bearing (4)
8. Retaining ring (4)
9. Journal assembly
10. Flange yoke
11. Lubrication fitting
12. Retaining ring (4)
13. Roller Bearing (4)
14. Journal assembly
15. Lubrication fitting
16. Flange yoke
17. Plug

Figure 5-5. Propeller shaft assembly exploded view.

5-12. Inspection and Repair

Replace any worn or damaged part. Clean all metal parts with a suitable solvent before inspection. Check that lubrication fittings (11, 5, and 15, fig. 5-5) are in good condition and not excessively worn. Always replace cork washer (4). Replace retaining rings if they have a permanent set. Replace damaged threaded items.

5-13. Reassembly

Refer to figure 5-5 and assemble the propeller shaft.

5-14. Installation

Refer to TM 5-3810-294-20 and install the propeller shaft.

Section III. REPAIR OF CRANE WORM SHAFT

5-15. Description

The worm shaft drives the worm wheel on the boom hoist shaft assembly (refer to fig. 5-1).

5-16. Removal

Refer to paragraph 2-19 and remove the worm shaft assembly.

5-17. Disassembly

Refer to figure 5-6 and disassemble the worm shaft as follows:

a. Remove cotter pin (1), nut (2), flange (3), and key (12). Nut (4) and lockwasher (5) are removed during removal of the assembly from the machine.

b. Remove retainer (7). Oil seal (6) comes off shaft (13) in the retainer.

c. Remove shims (8, 9, and 10). Remove shaft (13) from worm sleeve (15). Bearings (11 and 14) are removed with the shaft.

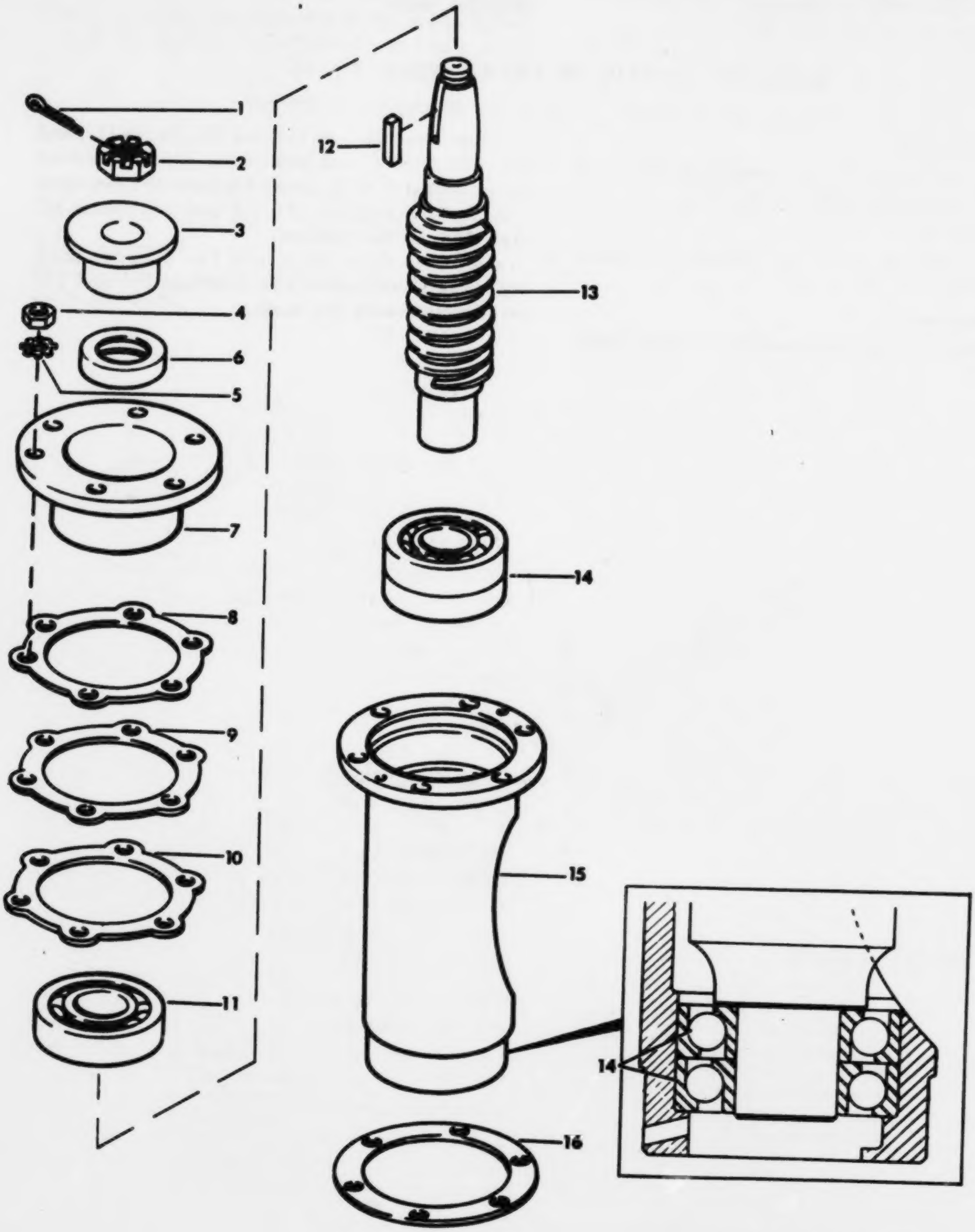

1
2
3
4
6
5
7
8
9
10
11
12
13
14
15
16
14
ME 3810-288-35/5-6

Figure 5-6. Worm shaft assembly exploded view.

KEY to fig. 5-6.
1. Cotter pin
2. Nut
3. Coupling flange
4. Nut (6)
5. Lockwasher (6)
6. Oil seal
7. Retainer
8. Shim
9. Shim
10. Shim
11. Bearing
12. Key
13. Worm shaft
14. Bearing (2)
15. Worm sleeve
16. Gasket

5-18. Inspection and Repair

Inspect worm shaft for signs of excessive wear or thread damage. Clean all parts in a suitable solvent. Discard gasket (16, fig. 5-6) shims (8, 9, and 10) unless shims are in very good condition. Be sure to replace with the same measured thickness of shims which were removed, because these shims determine the shaft end clearance. End clearance should be maintained at 0.003 to 0.005 inch. Replace bearings unless replacement bearings are not available. Clean key (12) with a fine file, if necessary, and be sure the key is a snug fit in shaft (13) keyway. Replace any part in doubtful condition.

5-19. Reassembly

Refer to figure 5-6 and assemble the worm shaft as follows:

a. Preheat bearing (11 and 14) and install bearings on proper ends of shaft (13). Bearings (14) are thrust bearings and must be assembled so that the thrust is absorbed in proper direction. Figure 5-6 shows how to install the bearings.

b. Install shaft and bearings into worm sleeve (15). Make sure bearings (14) are firmly against the inner shoulder in the worm sleeve, as shown in the insert.

c. Install oil seal (6) into retainer (7). Be sure sealing surface of shaft (13) is clean and free from burrs, and that seal (6) wiper lip points inward, toward worm portion of shaft (13).

d. Install gasket (16) over studs on the chain case on which worm sleeve (15) is mounted. Install shims (8, 9, and 10) on the face of worm sleeve (15), and place retainer (7) in the bore of sleeve (15).

e. Install key (12) and flange (3) and secure entire assembly with nut (2) and cotter pin (1).

5-20. Installation

Refer to paragraph 2-19 and install worm shaft assembly. The adjustment of the worm to worm wheel contact area is described in paragraphs 2-19 and 2-20.

Section IV. REPAIR OF BOOM HOIST SHAFT

5-21. Description

The boom hoist shaft is worm gear driven by a propeller shaft and worm gear coupled to the transmission output shaft (refer to fig. 5-1). The shaft drives the rear drumshaft assembly by means of a roller chain-drive sprocket arrangement from the left end of the shaft. The boom hoist drum is mounted on the right end of the shaft. The boom is both lifted and lowered under power by a planetary gear arrangement located in the boom hoist drum.

5-22. Removal and Disassembly

The boom hoist shaft must be disassembled to remove it. Refer to paragraph 2-20 and remove boom hoist shaft assembly.

5-23. Inspection and Repair

When the boom hoist shaft has been disassembled, clean all parts using a suitable solvent. Replace all O-rings, seals, bearings, gaskets, deformed shims, and other expendable parts. Inspect all parts for wear, scoring, cracks, or any other visible signs of damage, and replace any part not in good condition. Inspect the parts listed in table 1-2 for conformity with maximum clearances and replace any part worn beyond the maximum dimensions listed. Adjust end play by shimming, if necessary and maintain the tolerances listed.

5-24. Reassembly and Installation

The boom hoist shaft is reassembled as it is installed into the machine (refer to para 2-20). Do not attempt to assemble the boom hoist shaft and then install it.

Section V. REPAIR OF REAR DRUMSHAFT

5-25. Description

The rear drumshaft is used for the secondary load line in crane type applications, and as the hoist drum for digging applications. It is chain driven from the boom hoist shaft by a double-strand roller chain, which is enclosed in the rear drumshaft drive chaincase on the left rear of the crane, (refer to fig. 5-1). The lagging is of the split type to allow for easy replacement when switching to the special lagging used for shovel operation. The type of lagging on the drumshaft does not change the disassembly and reassembly procedures, but the methods of attaching the various front end attachments will necessarily change. These changes are described in TM 5-3810-294-10.

5-26. Removal

Refer to paragraph 2-15 and remove the rear drumshaft assembly.

5-27. Disassembly

Figure 5-7 illustrates the rear drumshaft assembly parts. Part one of the illustration shows the drumshaft as arranged for crane type operation. Part two shows it as arranged for shovel operation. Disassemble the rear drumshaft as follows:

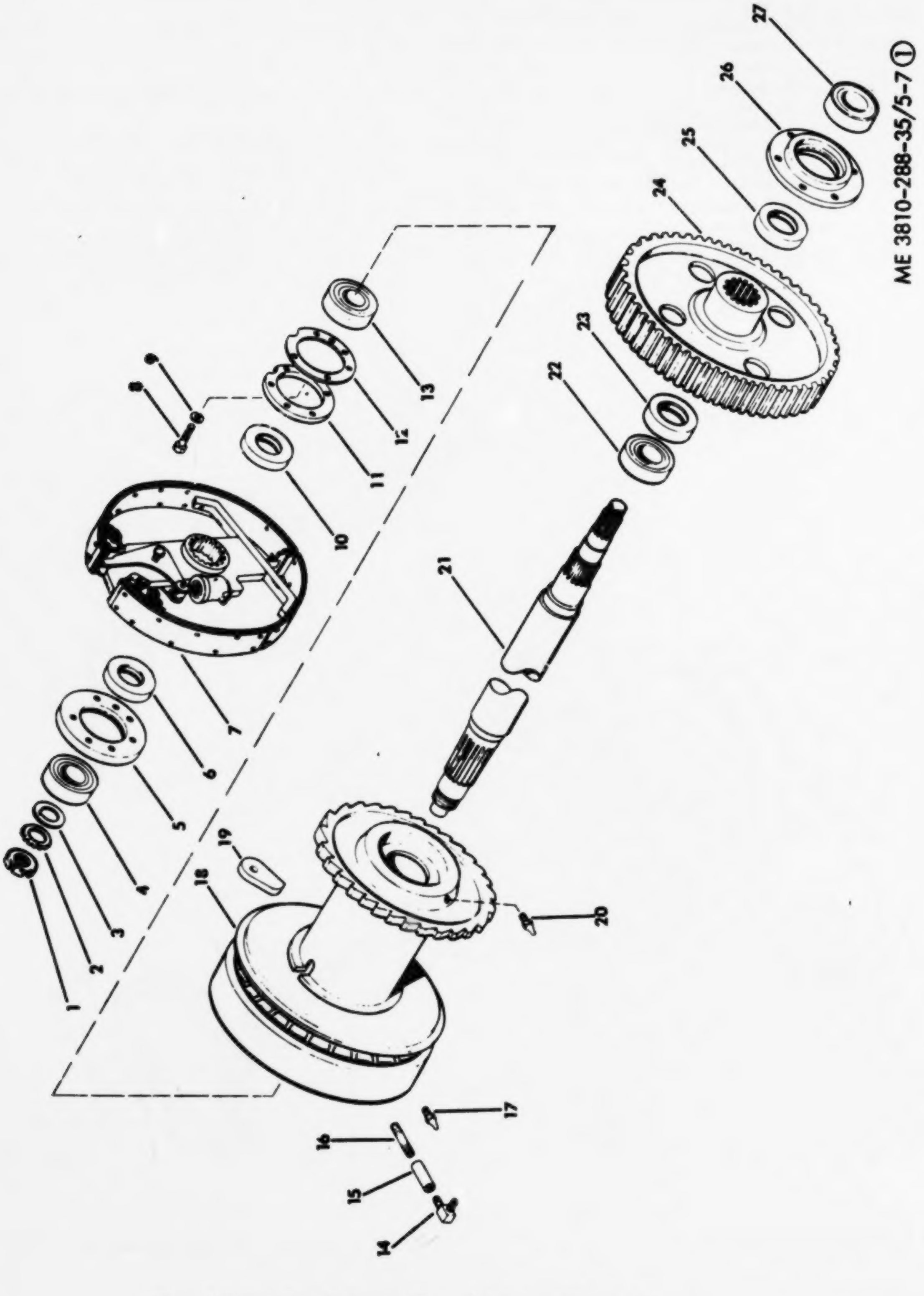
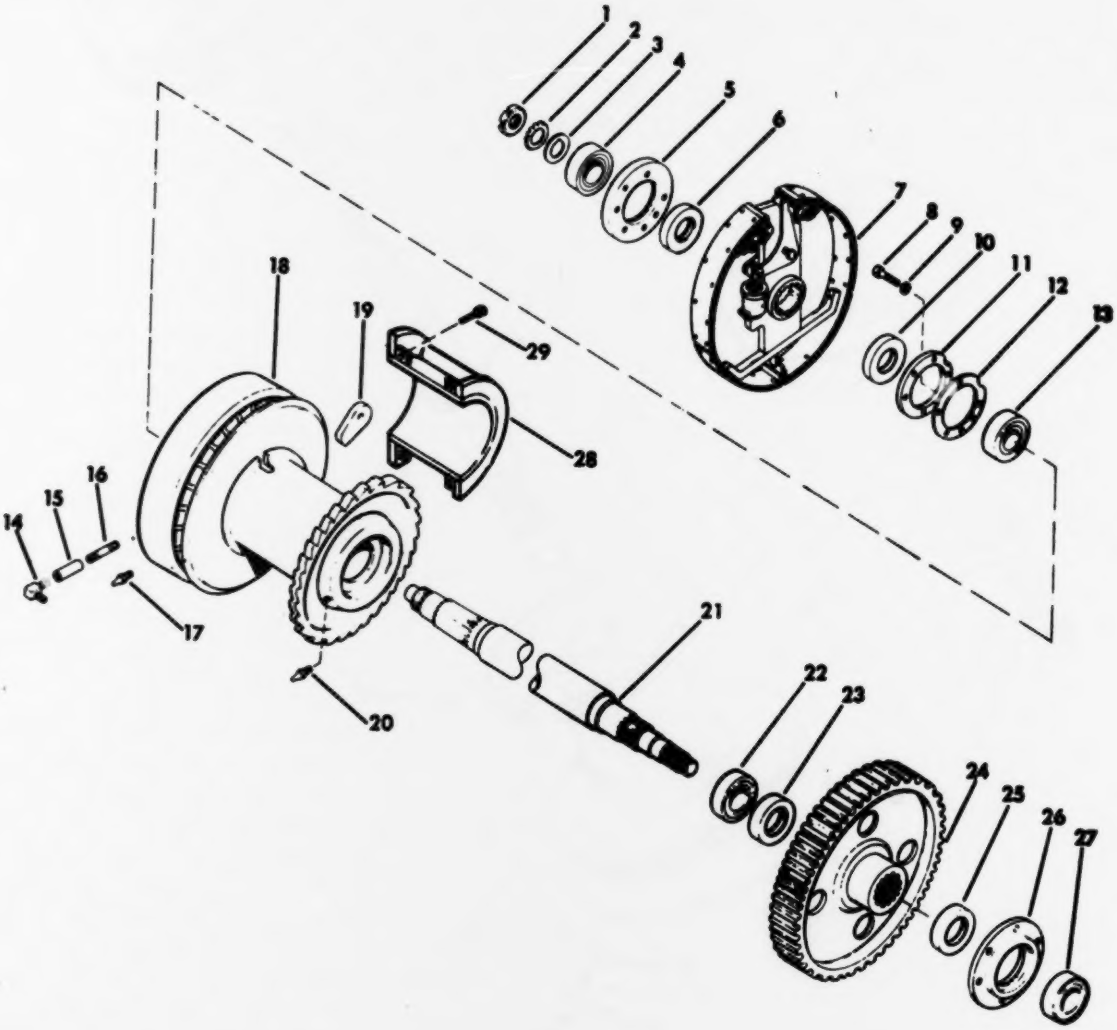

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
ME 3810-288-35/5-7 ①

Figure 5-7. Rear drumshaft assembly, exploded view. (Sheet 1 of 2)

KEY to fig. 5-7. sheets 1 and 2.

1. Nut
2. Lockwasher
3. Keyed washer
4. Bearing
5. Retainer
6. Seal
7. Clutch assembly
8. Capscrew (6)
9. Lockwasher (6)
10. Seal
11. Retainer
12. Gasket
13. Bearing
14. Male elbow
15. Pipe coupling
16. Pipe nipple
17. Grease fitting
18. Drum
19. Wedge
20. Grease fitting
21. Shaft
22. Bearing
23. Seal
24. Gear
25. Seal
26. Retainer
27. Bearing
28. Drum spacer (shovel only)
29. Capscrew (shovel only)


1
2
3
4
5
6
7
8
9
10
11
12
13
18
19
29
28
16
15
14
17
21
20
22
23
24
25
26
27

ME 3810-288-35/5-7 ②

Figure 5-7. Rear drumshaft assembly, exploded view. (Sheet 2 of 2)

a. Remove nut (1, fig. 5-7), lockwasher (2), and keyed washer (3). Remove items (14, 15, and 16).

b. Using a suitable puller, pull bearing (4) from shaft (21).

c. Remove retainer (5) with oil seal (6). Remove seal (6) from the retainer and discard the oil seal.

d. Remove clutch assembly (7) as a unit.

e. Figure 5-8 illustrates disassembly and assembly of the rear drum clutch. The front drum clutch is identical, except that spider (26) is opposite due to opposite drum rotation. Procedures apply to both front and rear drum clutches.

f. Remove oil seal (10). Remove capscrews (8) and lockwashers (9) and remove retainer (11) and gasket (12).

g. Remove bearing (27) using a suitable puller. Remove retainer (26) and seal (25).

h. Pull gear (24) from shaft (21).

i. Press shaft (21) out of drum (18) as shown. The shaft must be pressed out from left to right. Bearing (22) and seal (23) come out on the shaft. Remove bearing and seal from the shaft. Remove bearing (13) from opposite end of drum (18).

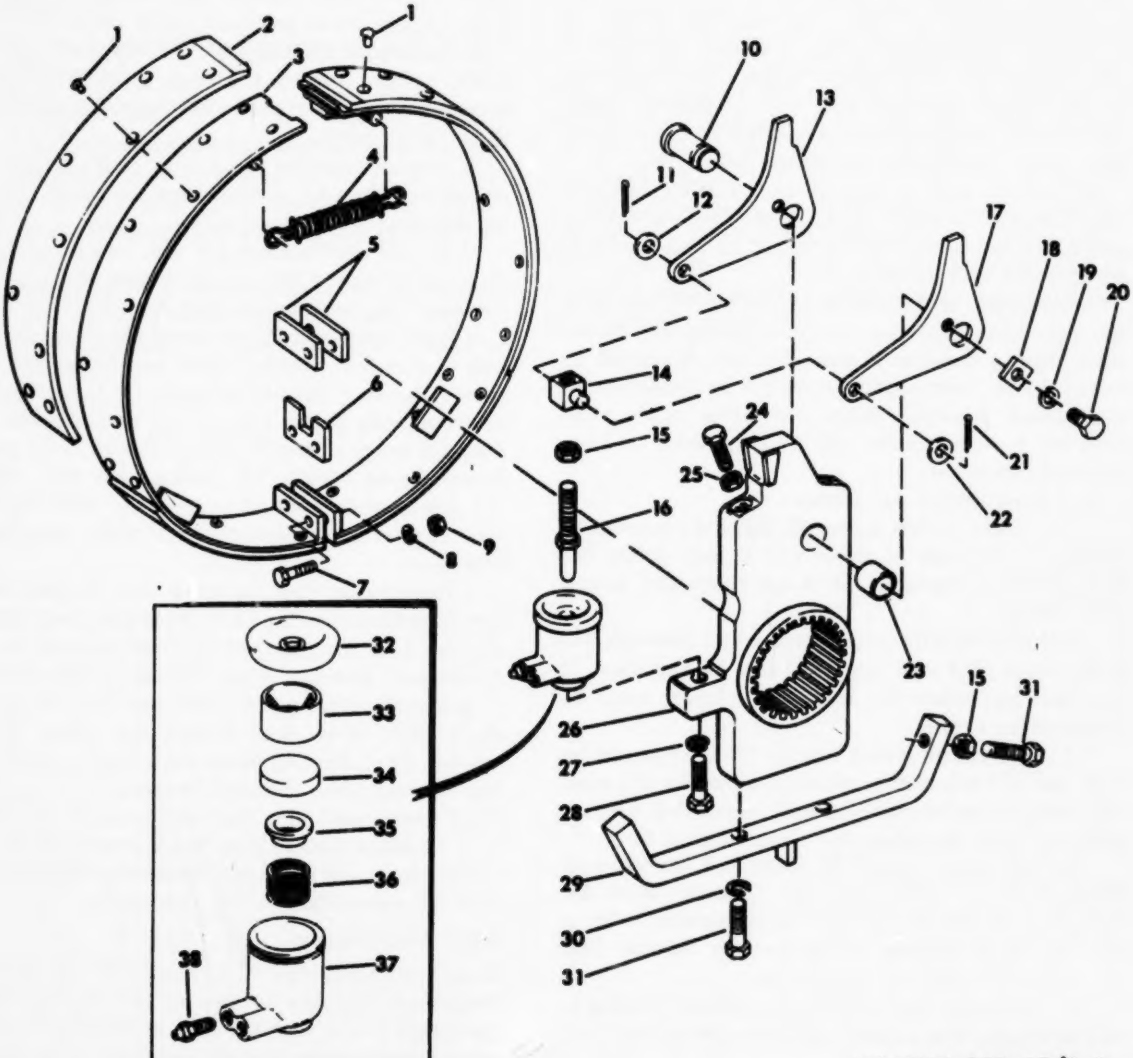


Figure 5-8. Front and rear drum clutch assembly exploded view.

KEY to fig. 5-8.
1. Rivet (20)
2. Clutch lining (2)
3. Clutch band (2)
4. Spring
5. Plate (2)
6. Plate
7. Capscrew (2)
8. Lockwasher (2)
9. Nut (2)
10. Pin
11. Cotter pin
12. Washer
13. Lever
14. Trunnion
15. Nut (3)
16. Adjusting pushrod
17. Lever
18. Keeper plate
19. Lockwasher
20. Capscrew
21. Cotter pin
22. Washer
23. Bushing
24. Capscrew
25. Nut
26. Spider
27. Lockwasher
28. Capscrew
29. Band guide
30. Lockwasher (2)
31. Capscrew (4)
32. Boot
33. Piston
34. Cup
35. Spring seat
36. Spring
37. Cylinder body
38. Bleeder fitting

5-28. Inspection and Repair

a. Clean all parts using a suitable solvent.

b. Replace all seals, gaskets, deformed shims, and other expendable parts.

c. Inspect all parts for wear, scoring, cracks, or any other visible signs of damage, and replace any parts not in good condition. Inspect gear teeth for severe wear, pitting, and for excessive tooth shortening. Pay particular attention to the roots of gear teeth to be sure no cracks are developing.

d. Inspect and smooth all seal seating surfaces with a fine oil stone or crocus cloth. The seal seating surfaces must be smooth, or rapid and severe wear of oil seals will develop.

e. Although the sprocket and chain which drive the rear drumshaft are removed from the drumshaft during removal of the assembly, it should be noted that a worn sprocket should be replaced. In that event, always replace the drive chain also, because a worn chain will quickly wear a new, unworn, sprocket.

f. Repair clutch as follows:

(1) When clutch lining (2, fig. 5-8) is worn to within 1 / 16 inch of rivets (1) at any point, the lining must be replaced. Drill out rivets and install new linings.

(2) If hydraulic cylinder (items 32 through 38) leaks, boot (32) and cup (34) can be replaced. If this does not repair the leak, the cylinder must be replaced as a unit.

(3) If wear on clutch linings (2) is apparent on only one end of a lining, which is normally the case, the linings may be reversed and reinstalled without relining, thus doubling the clutch lining life.

(4) All items should be inspected for signs of damage. Items with damaged threads must be replaced. Spring (4) should be compared with a new spring. If cracks, elongation, or deformation are apparent, replace the spring.

(5) Another plate (6) can be added if lining is still available, but adjustment from push rod (16) has been used up.

5-29. Reassembly

a. Block drum (18, fig. 5-7) to prevent it from moving either left or right. Install shaft (21) in the drum, prepack bearings (13 and 22) with GAA grease, and install bearings on the shaft. Bearings must bear firmly against the shoulders on shaft (21). Apply force to inner races only.

b. Lubricate all seals (6, 10, 23, and 25) with GAA grease. Install the seals in their respective retainers. Note that seal (23) must be installed in drum (18) bore.

c. Install retainer (11) and gasket (12) with capscrews (8) and lockwashers (9). Seal (10) will be installed with the retainer.

d. Install clutch assembly (7), being careful not to damage seal (10) as the clutch spider hub is pressed into position against bearing (13).

e. Install retainer (5) with seal (6) in place on the hub of clutch (7) spider. Heat and install the inner race of bearing (4) on the shaft (21), making sure the race butts firmly against the clutch spider hub. Prepack inner race of bearing (4) with GAA grease. Install keyed washer (3), lockwasher (2), and nut (1). Place outer race of bearing (4) over the inner race to prevent foreign material from entering the lubricant.

f. Install gear (24), making sure the gear hub is firmly against bearing (22). Note that item (23) is a seal and that the gear hub extends through the seal. Avoid seal damage when installing the gear.

g. Install retainer (26) with seal (25) in place on shaft (21). Heat and install the inner race of bearing (27), forcing inner race firmly against the hub of gear (24). Prepack bearing inner race with GAA grease and slide the outer race of the bearing over the inner race to keep the lubricant clean. This completes bench assembly, assuming that the drum is to be reinstalled in the machine.

5-30. Installation

Refer to paragraph 2-15 and install the rear drumshaft. Be sure to line up the marked hole in the clutch spider with the hole in the shaft to assure proper lubrication of shaft bearings. Also, be sure to install the elbow, coupling, and nipple shown on figure 2-6.

Section VI. REPAIR OF FRONT DRUMSHAFT

5-31. Description

The front drumshaft (refer to fig. 5-1) is used as the primary load line in crane type applications and as the digging drum for digging applications. It can be equipped with sprocket-type lagging for shovel application. The type of lagging on the drumshaft will not change the disassembly and reassembly procedures given in the following paragraphs, with the exception that the methods of attaching the various front end attachments will necessarily change. These procedures are described in TM 5-3810-294-10.

5-32. Removal

Refer to paragraph 2-16 and remove the front drumshaft assembly.

5-33. Disassembly

Figure 5-9 illustrates the front drumshaft assembly parts. Part one of the illustration shows crane drum arrangement and part two shows shovel drum arrangement. Disassemble the front drumshaft as follows:

a. Remove nut (1), lockwasher (2), and keyed washer (3). Remove items (15, 16, and 17).

b. Remove bearing (4) from shaft (34), using a suitable puller.

c. Slide retainer (5) and seal (6) off end of the shaft as an assembly. Remove and discard seal (6) and install another seal in retainer (5).

d. Slide clutch assembly (7) off shaft as an assembly. Refer to paragraph 5-27*e* for disassembly and reassembly instructions for this clutch.

e. Remove retainer (10) with seal (9) by removing capscrews (8). Remove gasket (11).

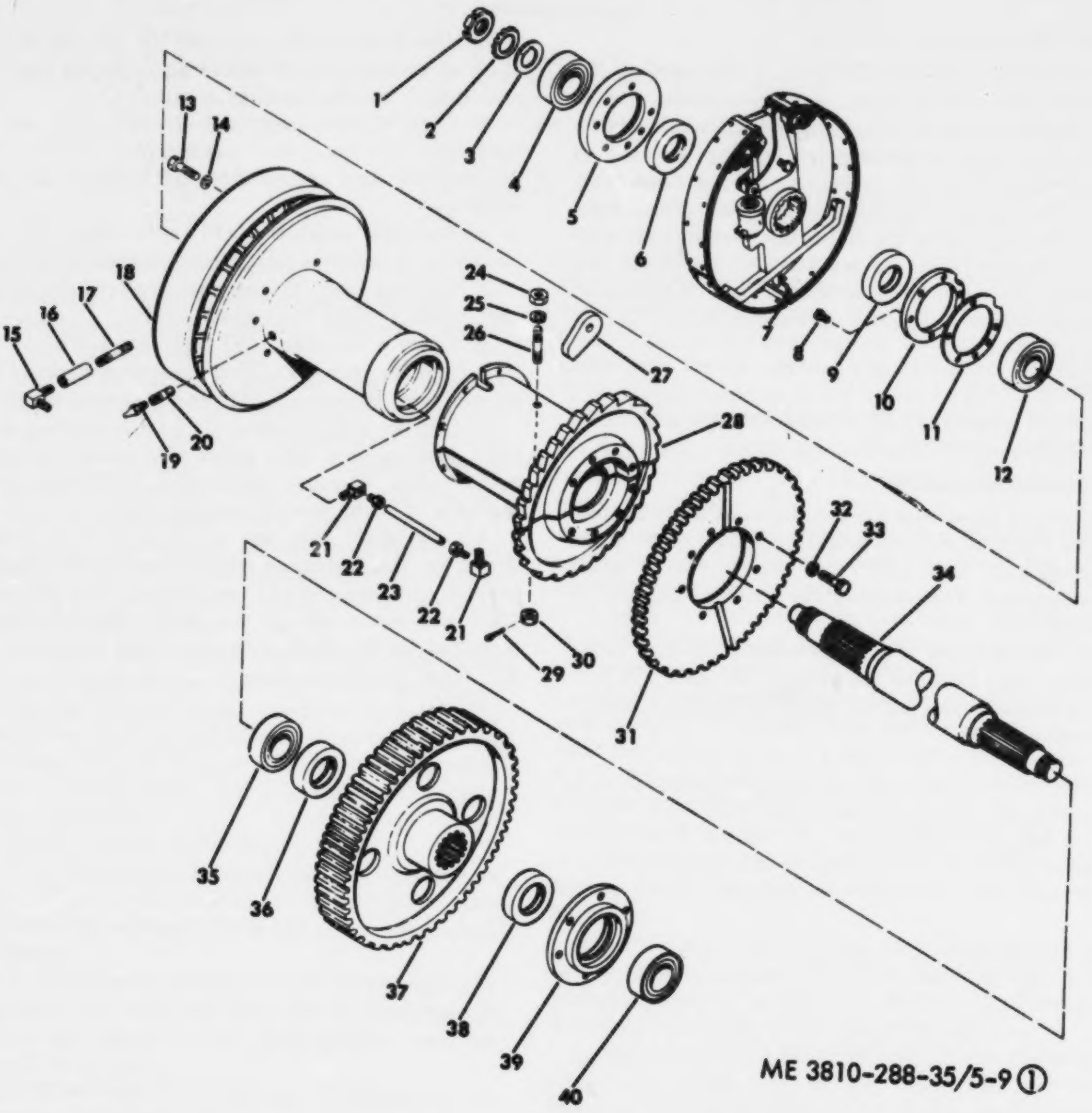
f. Working from the opposite end of the shaft, pull bearing (40) from shaft (34).

g. Remove retainer (39) and seal (38).

h. Remove gear (37). Then remove sprocket (31) by removing capscrews (33) and lockwashers (32).

i. Remove split lagging (28) by removing nuts (24), lockwashers (25), studs (26), nuts (30) and cotter pins. Remove capscrews (13) and lockwashers (14) to remove lagging (28).

j. Press shaft (34) out of drum (18) in either direction. Depending on which direction the shaft is pressed out, bearing (12) or bearing (35) and seal (36) will come off on the shaft. Remove items mounted on the shaft, and remaining items (12 or 35) from the drum bore.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
22
21
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
ME 3810-288-35/5-9 ①

1. Nut
2. Lockwasher
3. Keyed washer
4. Bearing
5. Retainer
6. Seal
7. Clutch assembly
8. Capscrew (6)
9. Seal
10. Retainer
11. Gasket
12. Bearing
13. Capscrew (8)
14. Lockwasher (8)
15. Male elbow
16. Pipe coupling
17. Pipe nipple
18. Drum
19. Grease fitting
20. Pipe nipple
21. Elbow (2)
22. Fitting (2)
23. Tube
24. Nut (2)
25. Washer (2)
26. Stud (2)
27. Wedge
28. Split lagging
29. Cotter pin (2)
30. Nut (2)
31. Sprocket
32. Lockwasher (10)
33. Capscrew (10)
34. Shaft
35. Bearing
36. Seal
37. Gear
38. Seal
39. Retainer
40. Bearing
41. Capscrew (2) (shovel only)
42. Sprocket lagging (shovel only)
43. Lockwasher (2) (shovel only)
44. Nut (2) (shovel only)

Figure 5-9. Front drumshaft assembly, exploded view. (Sheet 1 of 2).

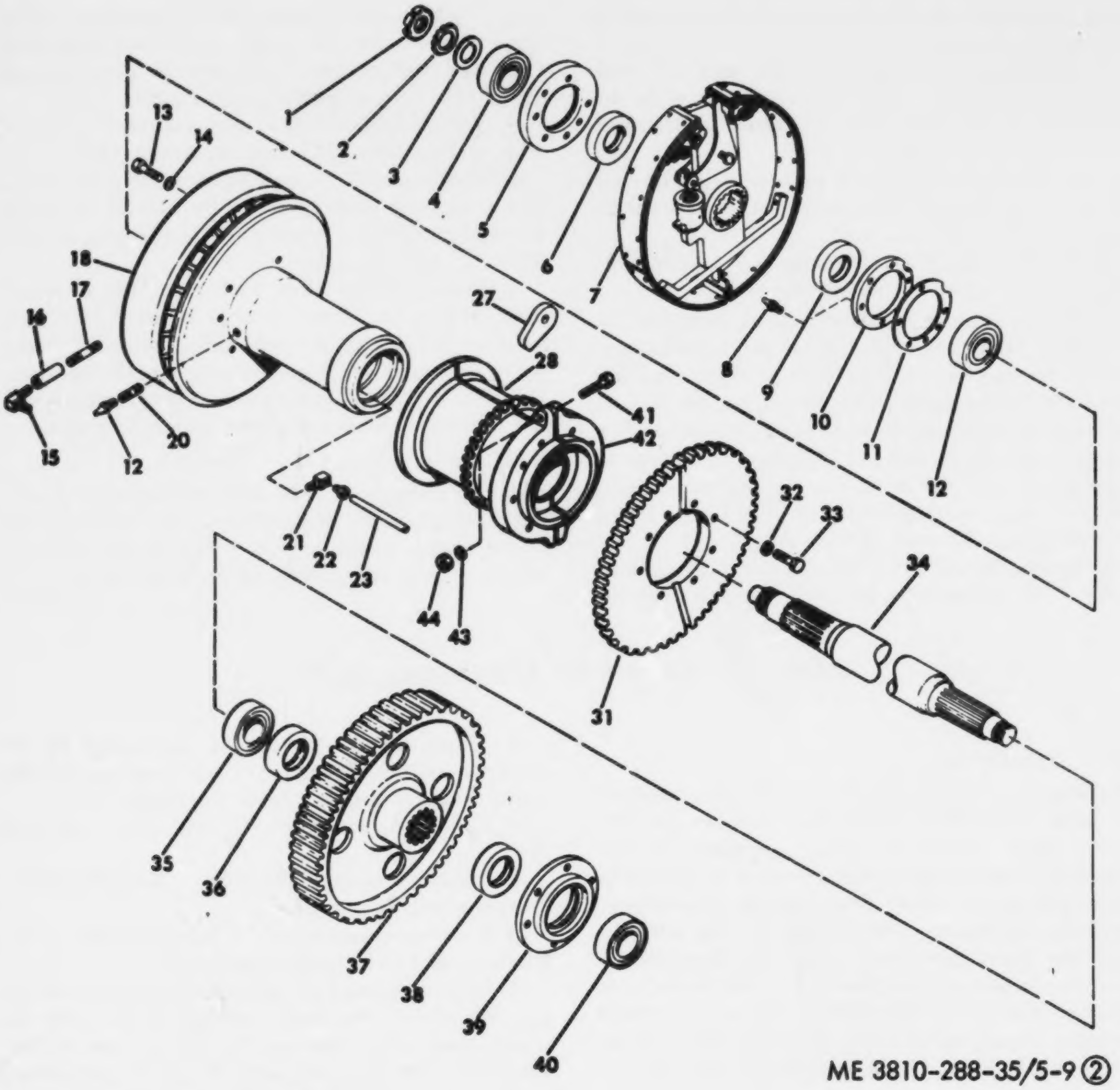


Figure 5-9. Front drumshaft assembly, exploded view. (Sheet 2 of 2).

5-34. Inspection and Repair

a. Clean all parts using a suitable solvent.

b. Replace all seals, gaskets, deformed shims, and other expendable parts.

c. Inspect all parts for wear, scoring, cracks, or any other visible signs of damage, and replace any parts not in good condition. Inspect gear teeth for severe wear, pitting, and for excessive tooth shortening. Pay particular attention to the roots of gear teeth to be sure no cracks are developing.

d. Inspect and smooth all seal seating surfaces with a fine oil stone or crocus cloth. The seal seating surfaces must be smooth or rapid and severe wear of oil seals will develop.

e. Repair of the front drum clutch is identical to that for the rear drum clutch. The only difference between the two clutches is that the spider (26, fig. 5-8) is reversed in the front drum due to opposite drumshaft rotation. Refer to paragraph 5-28 *f* and repair front drumshaft clutch.

5-35. Reassembly

a. Place drum (18, fig. 5-9) on a suitable stand and block it so that it cannot move. Install shaft (34) in the drum, making sure shaft is centered axially in the bore. Prepack bearings (12 and (35) with GAA grease and install bearings on the shaft, making sure they are pressed firmly against the shaft shoulders. Apply force to the inner races of the bearings only.

b. Lubricate all seals (6, 9, 36, and 38) and install seals in their respective retainers, with the exception of seal (36). This seal must be installed directly in drum (18).

c. Install gasket (11), and retainer (10) with seal (9) in place. Secure these items in position with capscrews (8).

d. Install clutch (7), being careful not to damage seal (9) as clutch hub enters the seal.

e. Install retainer (5), with seal (6) in place, on the hub of the clutch spider. Heat and install inner race of bearing (4) on shaft (34), making sure the race butts firmly against hub. Prepack inner race of the bearing with GAA grease. Install keyed washer (3), lockwasher (2), and nut (1). Place outer race of bearing (4) over the inner race to prevent foreign material from contaminating the lubricant. Place split lagging (28) over hub of drum (18).

f. Install fitting (19) and nipple (20). Install elbow (21), fitting (22), and tube (23). Be careful to install elbow (21) at both ends of tube (23) so that lubricant can reach both bearing (12) and (35).

g. Tighten split lagging (28) in position, using items (24, 25, 26, 29, and 30). Install capscrews (13) and lockwashers (14) around perimeter of drum (18) and extending into lagging (28).

h. Install sprocket (31) and secure in position with lockwashers (32) and capscrews (33).

i. Install gear (37), making sure the gear hub is firmly against bearing (35). Be careful to avoid damaging seal (36) when pushing the hub of gear (37) through the seal.

j. Place retainer (39) with seal (38) on shaft (34). Warm the inner race of bearing (40) and press race firmly against seal (38). Prepack bearing inner race with GAA grease and install the outer race over the inner race to prevent contamination of the lubricant. This completes bench assembly.

5-36. Installation

Refer to paragraph 2-16 and install front drumshaft assembly. Be sure to line up the marked hole in the clutch spider with the hole in the shaft to assure proper lubrication of shaft bearings.

Section VII. REPAIR OF REVERSING SHAFT

5-37. Description

The reversing shaft reverses direction of rotation of the front drumshaft (main load line) to provide power load lowering. Drum reversal is accomplished by engaging the reversing shaft clutch while leaving the front drum clutch disengaged. Since the reversing shaft is gear driven directly from the front drumshaft gear, the direction of rotation imparted to the front drumshaft is reversed. The front drumshaft is driven by a chain-sprocket arrangement from reversing shaft when the reversing shaft clutch is engaged (fig. 5-1).

5-38. Removal

Refer to paragraph 2-17 and remove the reversing shaft.

5-39. Disassembly

Refer to figure 5-10 and disassemble the reversing shaft as follows:

a. Stand assembly on end on suitable wooden blocking, with hub (3) facing downward.

b. Press shaft (2) out of the assembly in direction shown. Bearing (1) will come off on the shaft. Remove bearing from the shaft.

c. Remove spacer (22), O -ring (21), and seal (20).

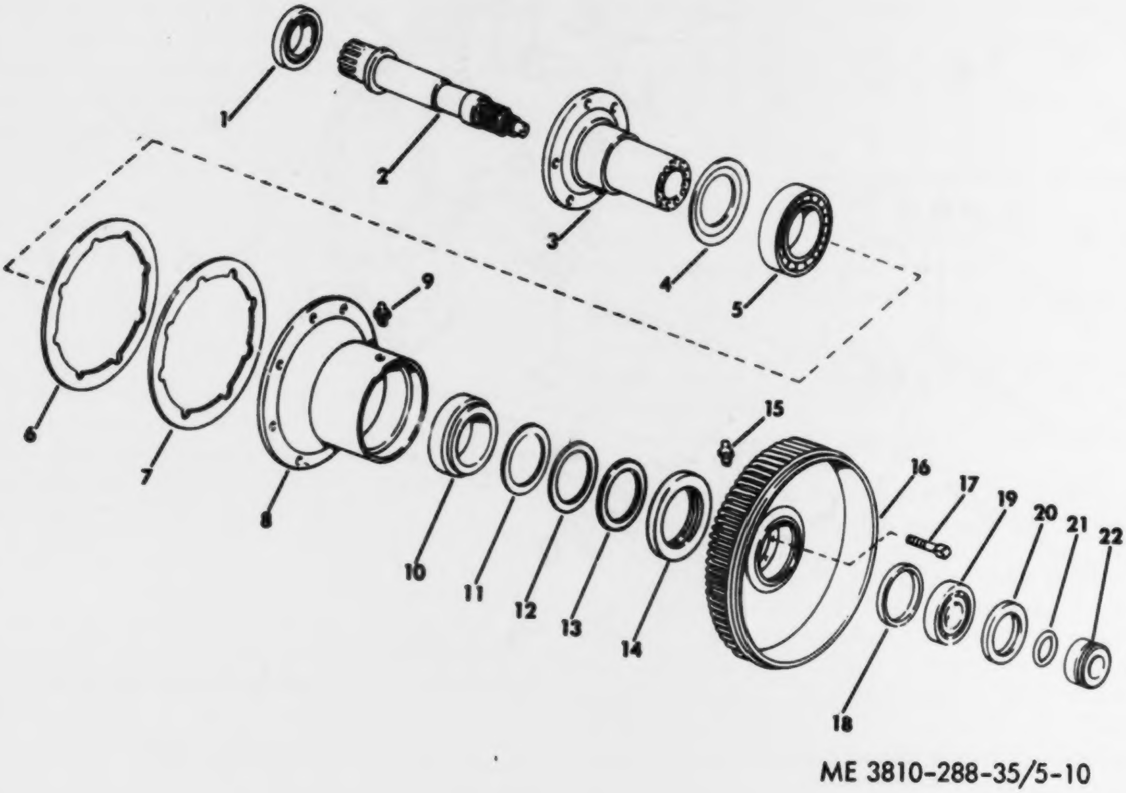
d. Remove bearing (19), using a suitable puller. Remove lock ring (18).

e. Remove capscrews (17). Remove drum (16). Remove seal (14) from drum (16).

f. Remove shims (11, 12, and 13). If they are in good condition, tie them together in the order in which they were removed for future use during assembly. If they are not in good condition, measure and record their total thickness for use during assembly.

g. Block clutch housing (8) and press reversing shaft hub (3) out of the clutch housing, pressing on the end of the hub which is tapped for capscrews (17). Bearing (10) will remain in housing (8). The inner race of bearing (5) will come off on hub (3).

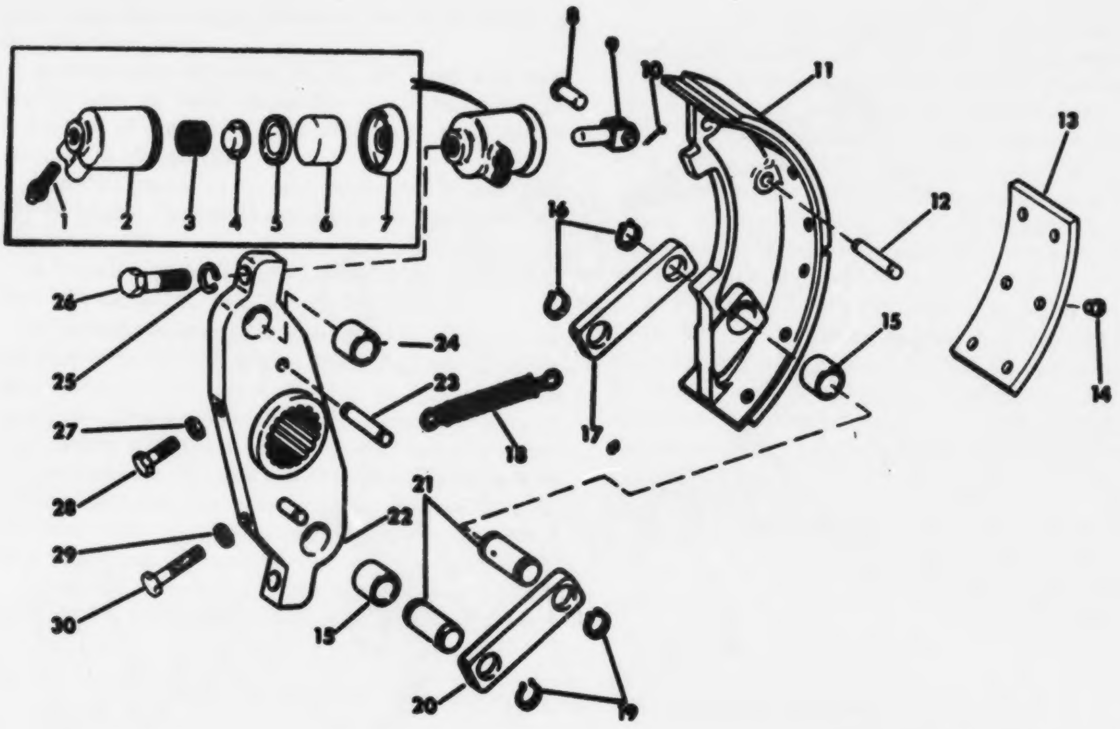
h. Remove shims (6 and 7), two grease fittings (15), and two relief fittings (9).



1. Bearing
2. Shaft
3. Reversing shaft hub
4. Bearing seal
5. Bearing
6. Shim
7. Shim
8. Reversing clutch housing
9. Relief fitting
10. Bearing
11. Shim
12. Shim
13. Shim
14. Seal
15. Grease fitting
16. Reversing shaft drum
17. Capscrew (12)
18. Lock ring
19. Bearing
20. Seal
21. O-ring
22. Spacer

Figure 5-10. Reversing shaft assembly exploded view.

i. Figure 5-11 illustrates disassembly and assembly of the reversing shaft clutch. An identical clutch is also used for the horizontal swing shafts, and procedures apply to both clutches. Two hydraulic cylinders and clutch shoes are provided, but only one is illustrated for simplicity.



ME 3810-288-35/5-11

1. Bleeder fitting (2)
2. Cylinder (2)
3. Spring (2)
4. Spring guide (2)
5. Cup (2)
6. Piston (2)
7. Boot (2)
8. Pin (2)
9. Link (2)
10. Cotter pin (2)
11. Clutch shoe (2)
12. Pin (2)
13. Lining (4)
14. Rivet (24)
15. Bushing (2)
16. Retaining ring (4)
17. Link (2)
18. Return spring (2)
19. Retaining ring (4)
20. Link (2)
21. Pin (4)
22. Spider
23. Pin (2)
24. Bushing (2)
25. Lockwashers (2)
26. Capscrew (2)
27. Nut (2)
28. Adjusting bolt (2)
29. Nut (2)
30. Adjusting bolt (2)

Figure 5-11. Reversing shaft clutch assembly exploded view.

5-40. Inspection and Repair

a. Clean all parts using a suitable solvent.

b. Replace all seals, gaskets, deformed shims, O -rings, and other expendable parts.

c. Inspect all parts for wear, scoring, cracks, or any other visible signs of damage, and replace any parts not in good condition.

d. Inspect and smooth all seal seating surfaces with a fine oil stone or crocus cloth. Seal seating surfaces must be smooth, or rapid and severe wear of oil seals will develop.

e. Repair clutch as follows:

(1) When clutch linings (13, fig. 5-11) are worn to within 1 / 16 inch of the rivet (14) heads at any point, repairs must be made. If wear is concentrated on one end of each brake shoe only, the shoes may be reversed, placing the unworn lining into use at the point where maximum wear occurred. If this has already been done once, the rivets must be drilled out and the lining must be replaced.

(2) If the hydraulic cylinder (items 1 through

7) leaks, boot (7) and cup (5) can be replaced. If this does not repair the leak, the cylinder must be replaced as a unit.

(3) All items must be inspected for signs of visible wear or damage. Items with damaged threads must be replaced. Compare spring (18) with a new spring of the same type. If the spring is elongated, or has any sign of a crack or deformation, replace the spring.

5-41. Reassembly

a. Install bearing seal (4, fig. 5-10) on hub (3).

b. Warm inner race of bearing (5) and install it on hub (3). Install outer race of the bearing in housing (8). Pack bearing (5) inner race with GAA grease.

c. Stand hub (3) on end, large end down.

d. Install outer race of bearing (10) in housing (8).

e. Install housing (8) on hub (3). Pack the area between bearings (5 and 10) with GAA grease. Warm and install inner race of bearing (10) over outer diameter of hub (3). Exact location on the hub does not matter at this time.

f. Install bearing (1) on shaft (2). Warm the bearing before installation and apply force against the inner race only, if necessary. Make sure bearing is firmly against shaft shoulder.

g. Install shaft (2) and bearing (1) in hub (3). Be sure the bearing fits firmly in the shoulder of hub (3).

h. Refer to figure 2-8 and install sprocket, end plate, and end plate capscrews illustrated. Do not lock wire capscrews, since they will be removed later in this assembly procedure.

i. Assemble drum (16) on hub (3), using three capscrews (17), evenly spaced. Do not install shims (11, 12, and 13) at this time. Tighten capscrews to 20 to 25 foot-pounds, using a torque wrench, and check shaft end-play with a dial indicating micrometer. Remove drum (16) and install sufficient shims (11, 12, and 13) to provide from 0.003 to 0.005 inch shaft end-play.

j. Press seal (14) into the bore of clutch housing (8). Pack sealing lips with GAA grease and install the seal with the spring pointing toward drum (16). Remove sprocket, end plate, and end plate capscrews installed in step h. above.

k. Install drum (16), using capscrews (17). Be sure to use correct measured amount of shims (11, 12, and 13). Tighten capscrews (17) to 20 to 25 foot-pounds.

l. Install lock ring (18), making sure the holes in the ring are located in line with grease fittings (15). Install relief fittings (9).

m. Warm bearing (19) and install it firmly against lock ring (18).

n. Press seal (20) into position in drum (16). Prepack seal with type GAA grease and be sure seal lip points toward bearing (19).

o. Install O -ring (21) in spacer (22). Lubricate bore of the spacer and O -ring, and slide the two items into position on shaft (2). Avoid damage to seal (20) as spacer (22) enters the seal. This completes bench assembly of the reversing shaft.

5-42. Installation

Refer to paragraph 2-17 and install the reversing shaft assembly.

Section VIII. REPAIR OF HORIZONTAL SWING SHAFT

5-43. Description

The horizontal swing shafts are located on each side of the vertical swing shaft (refer to fig. 5-1). Engaging the left horizontal swing shaft clutch turns the crane (revolving frame) to the right. Engaging the right horizontal swing shaft clutch turns the crane (revolving frame) to the left. Both shaft are identical in construction.

5-44. Removal

Refer to paragraph 2-18 and remove the horizontal swing shaft.

5-45. Disassembly

Disassemble the horizontal swing shaft as follows:

a. Remove lock wire (1, fig. 5-12), capscrews (2) and washer (3). Pull bevel pinion (4) from shaft (7) and remove spacer (5).

b. Stand assembly on end, with sprocket end of hub and sprocket (8) facing down. Make the blocking high enough to allow shaft (7) to be pressed out of the bottom of hub (8). Press shaft (7) out of hub (8). Bearing (6) will come off on shaft (7). Pull bearing (6) from shaft (7).

c. Remove spacer (28), O -ring (27), and seal (26).

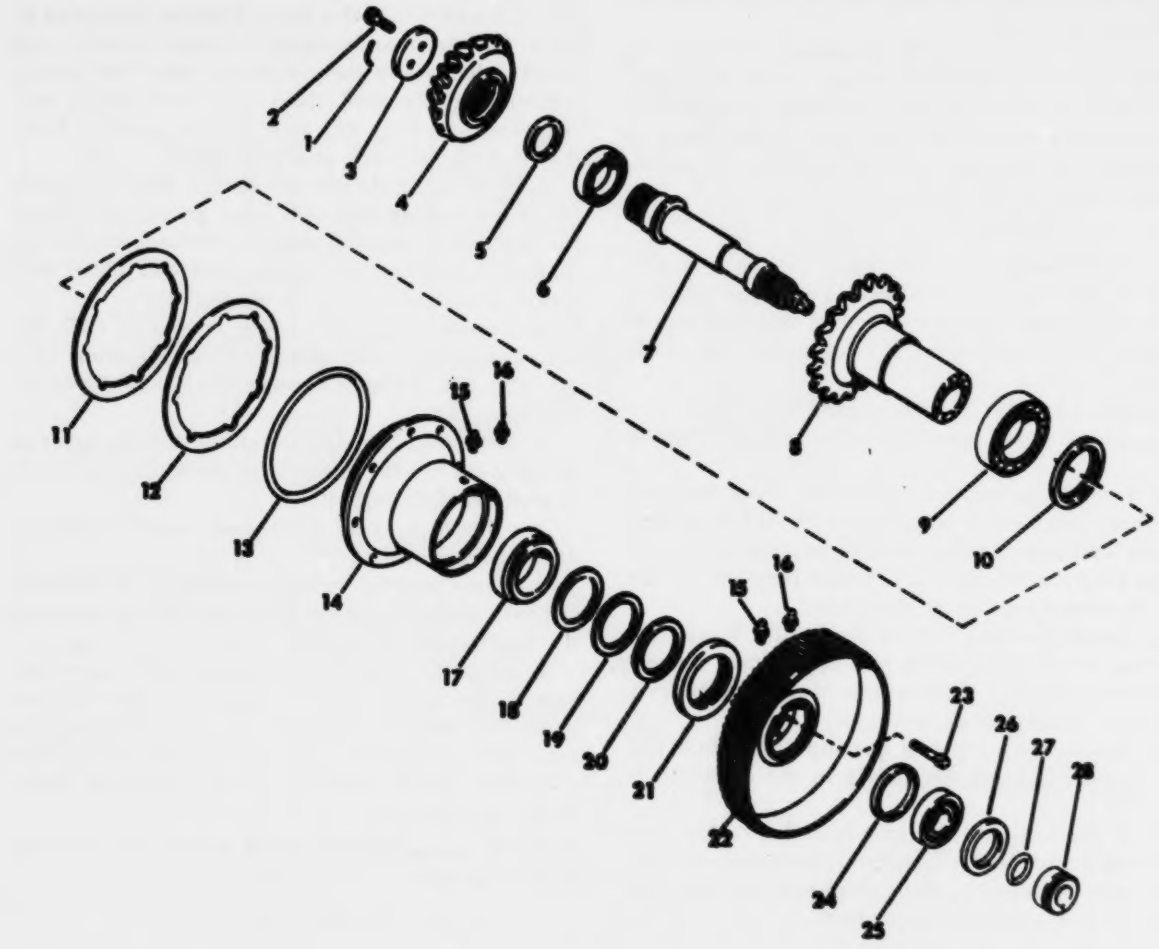
d. Remove bearing (25) from bore of drum (22), using a suitable puller. Remove lock ring (24).

e. Remove capscrews (23) and remove drum (22). Remove seal (21).

f. Remove shims (18, 19, and 20).

g. Block housing (14) and press hub and sprocket (8) out of the housing, pressing on the end of hub (8) which is tapped for capscrews (23). Bearing (17) will remain in housing (14) and the inner race of bearing (9) will come off on hub (8). All remaining parts may now be removed from housing (14) and hub (8).

h. Refer to paragraph 5-39 *i* for disassembly and reassembly instructions for the horizontal swing shaft clutch.



ME 3810-288-35/5-12

1. Lock wire
2. Capscrew (2)
3. Washer
4. Bevel pinion
5. Spacer
6. Bearing
7. Shaft
8. Hub and sprocket
9. Bearing
10. Seal
11. Shim
12. Shim
13. O -ring
14. Swing clutch housing
15. Grease fitting (2)
16. Relief fitting
17. Bearing
18. Shim
19. Shim
20. Shim
21. Seal
22. Drum
23. Capscrew (12)
24. Lock ring
25. Bearing
26. Seal
27. O -ring
28. Spacer

Figure 5-12. Horizontal swing shaft assembly exploded view.

5-46. Inspection and Repair

a. Clean all parts using a suitable solvent.

b. Replace all seals, gaskets, deformed shims, O -rings, and other expendable parts.

c. Inspect all parts for wear, scoring, cracks, or any other visible signs of damage or excessive wear. Replace any parts not in good condition. Inspect gear teeth for severe wear, pitting, and for excessive tooth shortening. Inspect the roots of gear teeth to be sure no cracks are developing. Inspect spacers for scoring.

d. Inspect and smooth all seal seating surfaces with a fine oil stone or crocus cloth. Seal seating surfaces must be smooth, or rapid and severe wear of oil seals will develop.

e. The horizontal swing shafts use the identical clutch as the reversing shaft assembly. Refer to paragraph 5-40 *e* for clutch repair information.

5-47. Reassembly

a. Install seal (10, fig. 5-12) and O -ring (13) in housing (14).

b. Warm inner race of bearing (9) and install it on hub and sprocket (8). Install outer race of bearing (9) in clutch housing (14). Prepack inner race of bearing (9) with type GAA grease.

c. Stand hub (8) on end, sprocket end down.

d. Install outer race of bearing (17) in clutch housing (14).

e. Install clutch housing (14) on hub and sprocket (8), being careful not to damage seal (10). Pack area between seal (10) and bearing (17) with type GAA grease. Warm and install inner race of bearing (9) over outer diameter of hub and sprocket (8).

f. Install bearing (6) on shaft (7). Warm bearing, and apply force to the inner race only. Be sure bearing fits firmly against the shaft shoulder.

g. Install shaft (7). and bearing (6) into hub and sprocket (8). Be sure bearing (6) fits firmly against the shoulder in hub and sprocket (8).

h. Install spacer (5) and bevel pinion (4) and secure these items in place with washer (3), capscrews (2), and lock wire (1).

i. Assemble drum (22) on hub (8), using three capscrews (23), evenly spaced. Do not install shims (18, 19, and 20) at this time. Tighten the three capscrews to 20 to 25 foot-pounds, using a torque wrench. Check shaft end-play, using a dial indicating micrometer. End-play should be from 0.003 to 0.005 inch. Remove clutch drum (22) and install sufficient shims (18, 19, and 20) to provide above end-play.

j. Press seal (21) into bore of housing (14). All seals in this assembly should be installed with their sealing lips pointing toward bevel pinion (4).

k. Reinstall drum (22) using capscrews (23), with the measured amount of shims (18, 19, and 20) in place. Tighten capscrews (23) to 20 to 25 foot-pounds.

l. Install lock ring (24), making sure the hole in the ring is located directly in line with grease fitting (15). Bearing (25) may not receive adequate lubrication if the lock ring is incorrectly installed.

m. Warm bearing (25) and install it firmly against lock ring (24).

n. Install seal (26) in the bore of drum (22). Be sure seal seating surface on spacer (28) is clean and free from nicks and burrs, because minor spacer imperfections can wear seal lips rapidly. Lubricate the seal with type GAA grease before installation.

o. Install O -ring (27) on spacer (28) and slide the assembly into position on shaft (7), being careful to avoid damage to seal (26). This completes bench assembly of the horizontal swing shaft.

5-48. Installation

Refer to paragraph 2-18 and install the horizontal swing shaft.

Section IX. REPAIR OF OF SWING BRAKE SHAFT

5-49. Description

The swing brake shaft mates with the slewing ring (refer to fig. 5-1). The swing brake is used to prevent the crane (revolving frame) from rotating when desired.

5-50. Repair Procedures

The swing brake shaft must be totally disassembled during removal. For that reason, repair is handled during removal and installation. Refer to paragraph 2-22 for swing brake shaft repair procedures.

Section X. REPAIR OF VERTICAL SWING SHAFT

5-51. Description

The vertical swing shaft is driven by the horizontal swing shaft. The shaft terminates in a pinion which mates with the gear in the slewing rim (refer to fig. 5-1).

5-52. Repair Procedures

The vertical swing shaft must be totally disassembled during removal. For that reason, repair is handled during removal and installation. Refer to paragraph 2-21 for vertical swing shaft repair procedures.

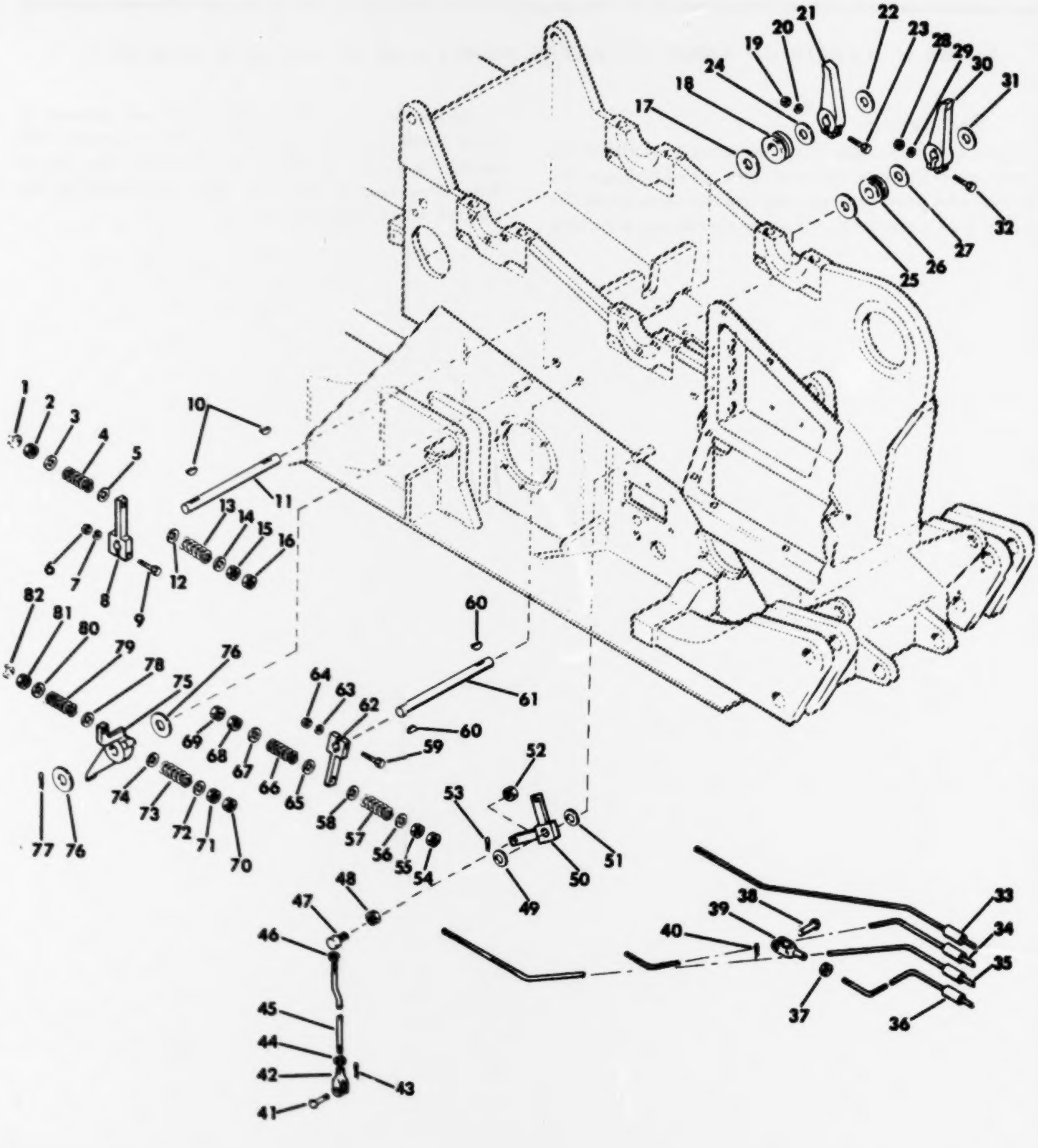
CHAPTER 6

REPAIR OF CRANE LOCKS, BRAKES AND PAWLS

Section I. REPAIR OF HAND OPERATED PAWLS AND SWING LOCK ASSEMBLY

6-1. Description

Figure 6-1 illustrates the components of the front drum pawl linkage, the rear drum pawl linkage, the boom hoist pawl linkage, and the connections to the swing lock assembly. All three pawls are provided to lock their respective drumshaft and prevent it from turning when engaged by the operator. The swing lock is designed to prevent the crane (revolving frame) from turning in relation to the carrier when engaged.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82

ME 3810-288-35/5-14

Figure 6-1. Hand operated pawls and swing lock assembly exploded view.

KEY to fig. 6-1.

1. Nut
2. Nut
3. Washer
4. Spring
5. Washer
6. Nut
7. Washer
8. Lever
9. Capscrew
10. Key (2)
11. Shaft
12. Washer
13. Spring
14. Washer
15. Nut
16. Nut
17. Washer
18. Spacer
19. Washer
20. Washer
21. Rear drum pawl
22. Washer
23. Capscrew
24. Washer
25. Washer
26. Spacer
27. Washer
28. Nut
29. Washer
30. Front drum pawl
31. Washer
32. Capscrew
33. Rod
34. Rod
35. Rod
36. Rod
37. Nut
38. Pin
39. Clevis
40. Cotter pin
41. Capscrew
42. Clevis
43. Cotter pin
44. Nut
45. Rod
46. Nut
47. Pin
48. Nut
49. Washer
50. Lever
51. Washer
52. Nut
53. Cotter pin
54. Nut
55. Nut
56. Washer
57. Spring
58. Washer
59. Capscrew
60. Key (2)
61. Shaft
62. Lever
63. Washer
64. Nut
65. Washer
66. Spring
67. Washer
68. Nut
69. Nut
70. Nut
71. Nut
72. Washer
73. Spring
74. Washer
75. Boom hoist pawl
76. Washer (2)
77. Cotter pin
78. Washer
79. Spring
80. Washer
81. Nut
82. Nut

6-2. Replacement

Refer to figure 6-1 and replace any faulty component of the hand operated pawls or swing linkages.

6-3. Adjustment

Adjust pawl linkages as described in TM 5-3810-294-20 before returning machine to service.

Section II. REPAIR OF AUTOMATIC PLANETARY BOOM HOIST PAWLS

6-4. Description

The planetary pawl friction shoes (fig. 6-2) constantly take positions determined by the direction of rotation of the boom hoist clutch drum. While the boom is being lowered, the friction shoes engage automatic pawls, preventing the clutch drum from turning with the boom hoist drum. This forces the boom down under power, through planetary pinions, rather than allowing the boom to be lowered by gravity.

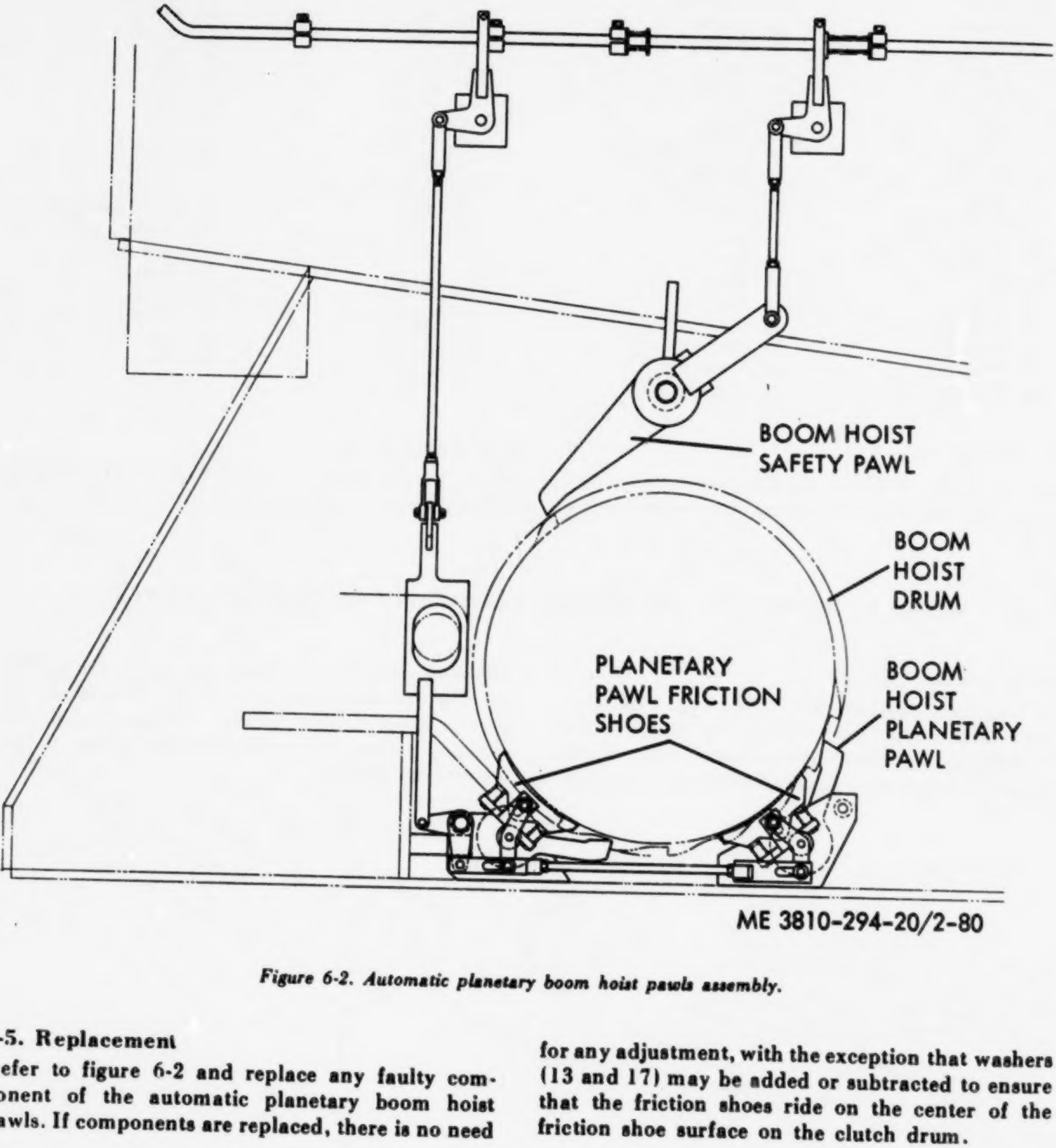

BOOM HOIST SAFETY PAWL
BOOM HOIST DRUM
PLANETARY PAWL FRICTION SHOES
BOOM HOIST PLANETARY PAWL
ME 3810-294-20/2-80

Figure 6-2. Automatic planetary boom hoist pawls assembly.

6-5. Replacement

Refer to figure 6-2 and replace any faulty component of the automatic planetary boom hoist pawls. If components are replaced, there is no need for any adjustment, with the exception that washers (13 and 17) may be added or subtracted to ensure that the friction shoes ride on the center of the friction shoe surface on the clutch drum.

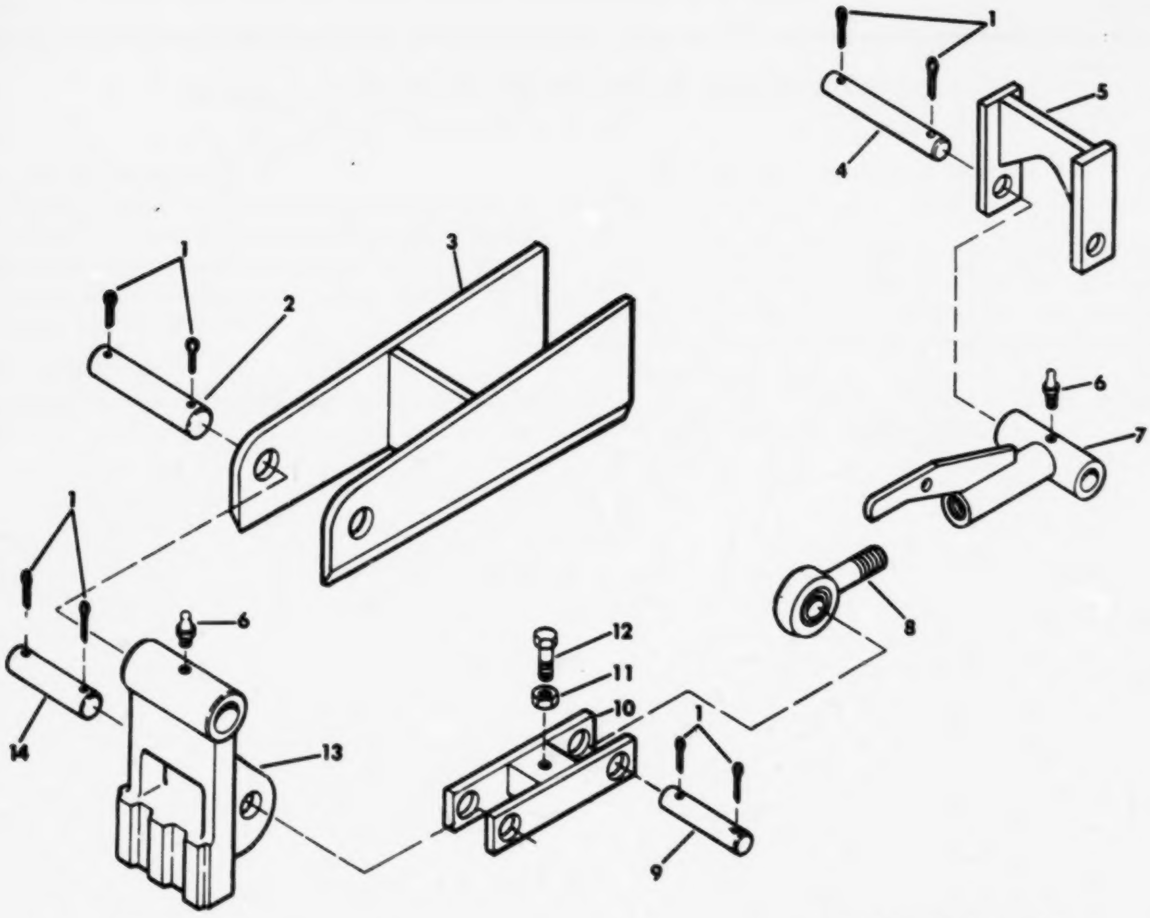
Section III. REPAIR OF SWING LOCK

6-6. Description

The swing lock prevents the revolving frame from moving in relation to the carrier.

6-7. Disassembly

Refer to figure 6-3 and disassemble the swing lock. Note that bracket (3) is welded to the revolving frame and is shown in figure 6-3 for reference purposes only.



ME 3810-288-35/5-21

1. Cotter pins (8)
2. Pin
3. Bracket
4. Pin
5. Bracket
6. Grease fitting (2)
7. Toggle lever
8. Rod end
9. Pin
10. Toggle link
11. Jam nut
12. Capscrew
13. Swing lock dog
14. Pin

Figure 6-3. Swing lock assembly exploded view.

6-8. Cleaning, Inspection, and Repair

Clean all swing lock parts in cleaning solvent and wipe dry. Inspect all pins and bores for scoring, galling, excessive wear, or any other damage. Replace any worn or damaged part.

6-9. Reassembly

Refer to figure 6-3 and reassemble the swing lock.

CHAPTER 7

REPAIR OF CRANE CAB COMPONENTS AND CONTROLS

Section I. REPAIR OF SWING BRAKE CONTROL STAND

7-1. Description

The swing brake control stand provides for an interface between the operator and the swing brake. The swing brake lever is equipped with a toggle arrangement which keeps the brake applied until released by the operator.

7-2. Disassembly

Disassemble the swing brake control stand as follows:

a. Remove the compensator (16, fig. 7-1) from compensator bracket (20). Refer to paragraph 7-6).

b. Remove cotter pins (19 and 25) from pins (23 and 24) and press pin (23 and 24) out of compensator bracket (20). Note that spacers (4, 11, and 14) will be free and can be removed from the compensator bracket.

c. Remove the remaining parts of the swing brake control stand as necessary.

KEY to fig. 7-1.

1. Hand lever knob
2. Hand lever
3. Grease fitting
4. Spacer (2)
5. Bearing
6. Flat washer
7. Link (2)
8. Spacer (4)
10. Bushing
11. Spacer (2)
12. Link (2)
13. Rod end
14. Spacer
15. Jam nut
16. Compensator
17. Capscrew (3)
18. Pin (2)
19. Cotter pin (4)
20. Compensator bracket
21. Lockwasher (3)
22. Nut (3)
23. Pin
24. Pin
25. Cotter pin (2)
26. Capscrew
27. Jam nut

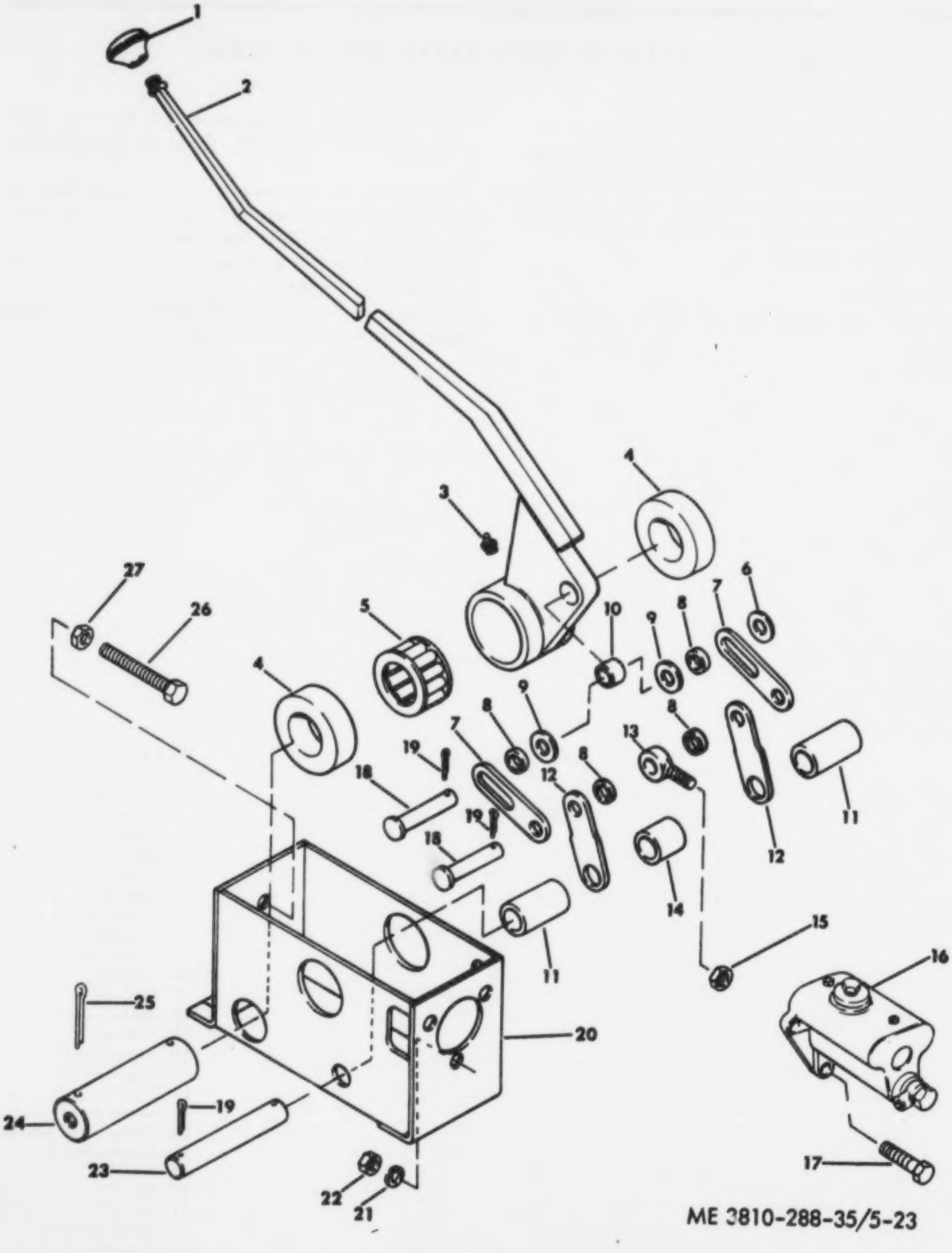

1
2
3
4
4
5
6
7
7
8
8
8
8
9
9
10
11
11
12
12
13
14
15
16
17
18
18
19
19
19
20
21
22
23
24
25
26
27
ME 3810-288-35/5-23

Figure 7-1. Swing brake control stand assembly exploded view.

7-3. Cleaning, Inspection, and Repair

Clean all parts of the swing brake control stand in cleaning solvent and wipe dry. Inspect all pins, links, and spacers for excessive wear or scoring. Replace any scored or damaged parts.

7-4. Reassembly

Refer to figure 7-1 and reassemble the swing brake control stand.

Section II. REPAIR OF MASTER CYLINDER

7-5. Description

The master cylinder housing includes a fluid reservoir and a cylinder bore. There is an intake port and a compensating (bypass) port between the cylinder and the reservoir. In the neutral position, fluid bypasses to compensate the closed hydraulic system for temperature expansion and contraction or seepage. During application of a brake or clutch, initial piston movement seals off the bypass port. Further piston movement displaces fluid into the line. As fluid movement increases, pressure builds up in the system, actuating the hydraulic cylinder at the selected brake or clutch.

7-6. Removal

Refer to TM 5-3810-294-20 for master cylinder removal procedures.

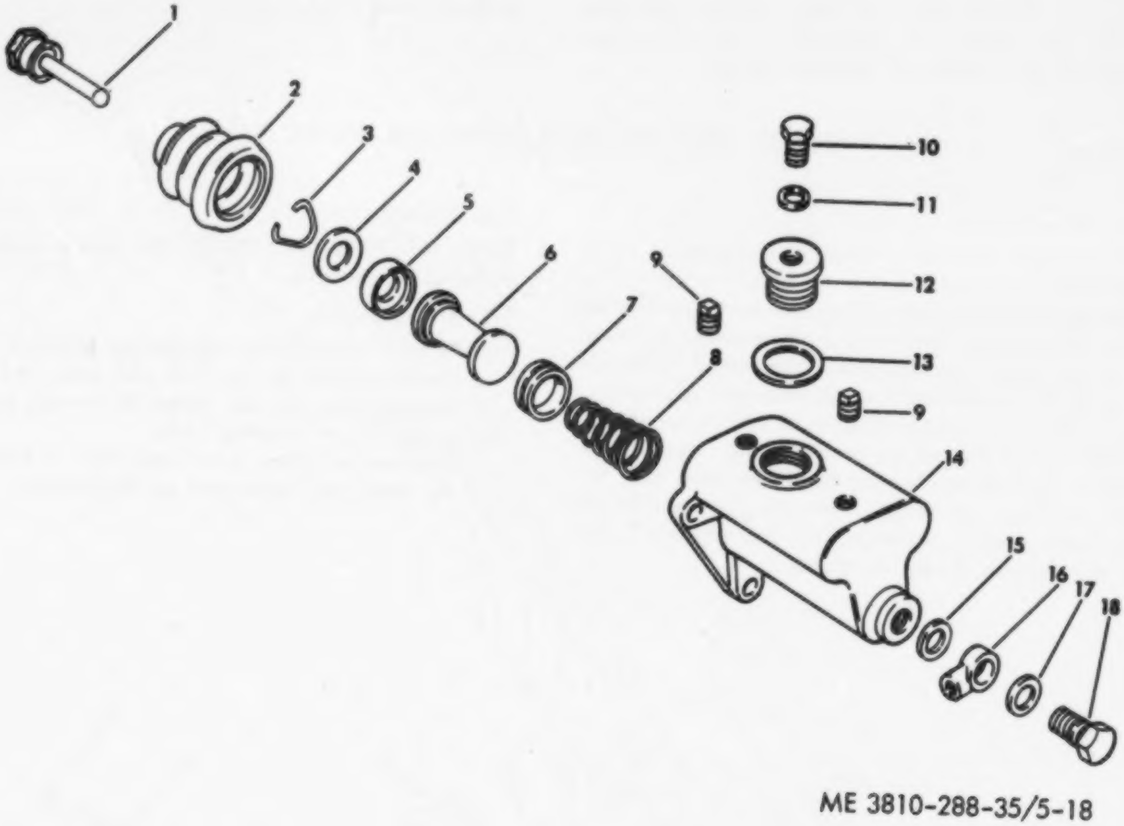
7-7. Disassembly

Disassemble the master cylinder as follows:

a. Remove boot (2, fig. 7-2) and push rod (1).

b. Remove stop wire (3). Items (4 through 8) will now come out of housing (14).

c. Remove all other parts attached to housing (14) by removing capscrews as illustrated.



1. Push rod
2. Boot
3. Stop wire
4. Piston stop washer
5. Secondary cup
6. Piston
7. Primary cup
8. Spring
9. Pipe plug (2)
10. Capscrew
11. Washer
12. Filler plug
13. Gasket
14. Housing
15. Washer
16. Fitting
17. Washer
18. Capscrew

Figure 7-2. Master cylinder assembly exploded view.

7-8. Inspection, Cleaning and Repair

a. Clean housing and all other parts with a suitable solvent. Immediately after cleaning, rinse parts in hydraulic fluid of the type used in the system to remove all traces of solvent. Use compressed air or clean, dry, lint-free cloth to dry parts after cleaning.

b. Hold housing toward a strong light and sight through the cylinder bore. Blemishes such as pitting, scratches, and visible wear patterns are cause for replacement of the entire assembly.

c. Use a hone to remove accumulations of dirt or gummy substances not removed during the cleaning process. The hone may also be used to "clean up" the interior of the housing bore, provided it does not increase bore diameter. Indication that the bore has been honed previously is cause for immediate replacement.

d. Check bore diameter with an inside micrometer and against a new cylinder. Maximum difference between a new cylinder and an old one is 0.007 inch. An alternate method is to insert piston (6, fig. 7-2) in housing (14) and check with a wire feeler gage. Maximum clearance is 0.007 inch.

e. Be sure that honed housing has no burr at the compensating port, because this will damage the cup lips and cause the cylinder to leak. Remove burrs with a deburring tool.

f. Make sure intake and compensating ports (the holes between housing bore and housing reservoir) are open. It is difficult to see the compensating port, but a soft copper wire not larger than 0.020 inch diameter can be used to probe the parts without danger of damage.

g. Replace spring (8) if any sign of cracks, damage, or permanent set are visible. Compare the spring to a new spring, if possible. Replace cups (5 and 7) whenever piston is removed.

7-9. Reassembly

a. If any parts (9 through 18) have been removed, replace them as shown in figure 7-2. Lubricate all parts with fluid of the type used in the system.

b. Install spring (8) in housing (14) as shown. Install cups (7 and 5) on piston (6) and install piston (6) in housing (14).

c. Install washer (4) and lock wire (3).

d. Place boot (2) over end of housing (14) and install push rod (1). It will be necessary to wrap the assembly for protection if it is not to be reinstalled in the machine immediately. The wrapping should be sufficiently tight to prevent push rod (1) from being lost.

Section III. REPAIR OF ENGINE CONTROL PANEL

7-10. Description

The control panel consists of switches, gages, and control devices as required to control and monitor all engine functions.

7-11. Removal

The panel can be removed as an assembly by removing the eight mounting screws located around the perimeter of the panel and removing electrical leads.

Warning: **Always disconnect battery cables before attempting to remove the control panel. If the panel is accidentally grounded with the battery cables installed, the panel will be destroyed and serious injury to personnel could result.**

7-12. Repair Procedures

Refer to TM 5-3810-294-20 for engine control panel repair procedures.

Section IV. REPAIR OF OPERATOR'S SEAT

7-13. Removal

Refer to TM 5-3810-294-20 for removal and installation procedures of operator's seat.

7-14. Repair Procedures

Refer to figure 7-3 and repair or replace any faulty item of the operator's seat assembly.

KEY to fig. 7-3.
1. Nut (2)
2. Washer (2)
3. Frame
4. Capscrew (2)
5. Back cushion
6. Seat cushion
7. Capscrew (4)
8. Washer (4)
9. Washer (4)
10. Washer (4)
11. Nut (4)
12. Bracket
13. Pin with chain
14. Stand

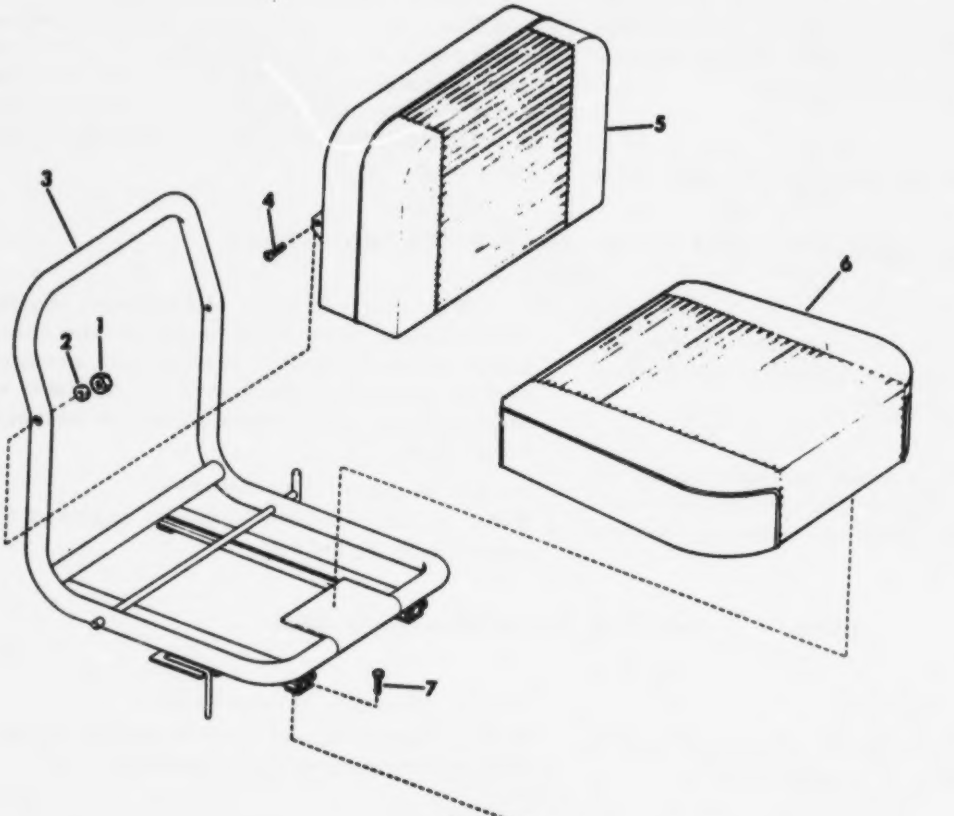

1
2
3
4
5
6
7
8
9
10
11
12
13
14
ME 3810-288-35/5-13

Figure 7-3. Operator's seat assembly exploded view.

CHAPTER 8

REPAIR OF REVOLVING FRAME AND WIRING HARNESS

Section I. REPAIR OF HOOK ROLLER

8-1. Description

This machine has three hook rollers, one on the front of the machine and two on the rear of the machine. Each hook roller consists of a mounting bracket attached to the revolving frame, eccentric pins, and rollers which contact the roller path. The hook rollers are used to reduce the strains transmitted to the center gudgeon, and prevents the upper from tipping and damaging the center gudgeon.

8-2. Removal

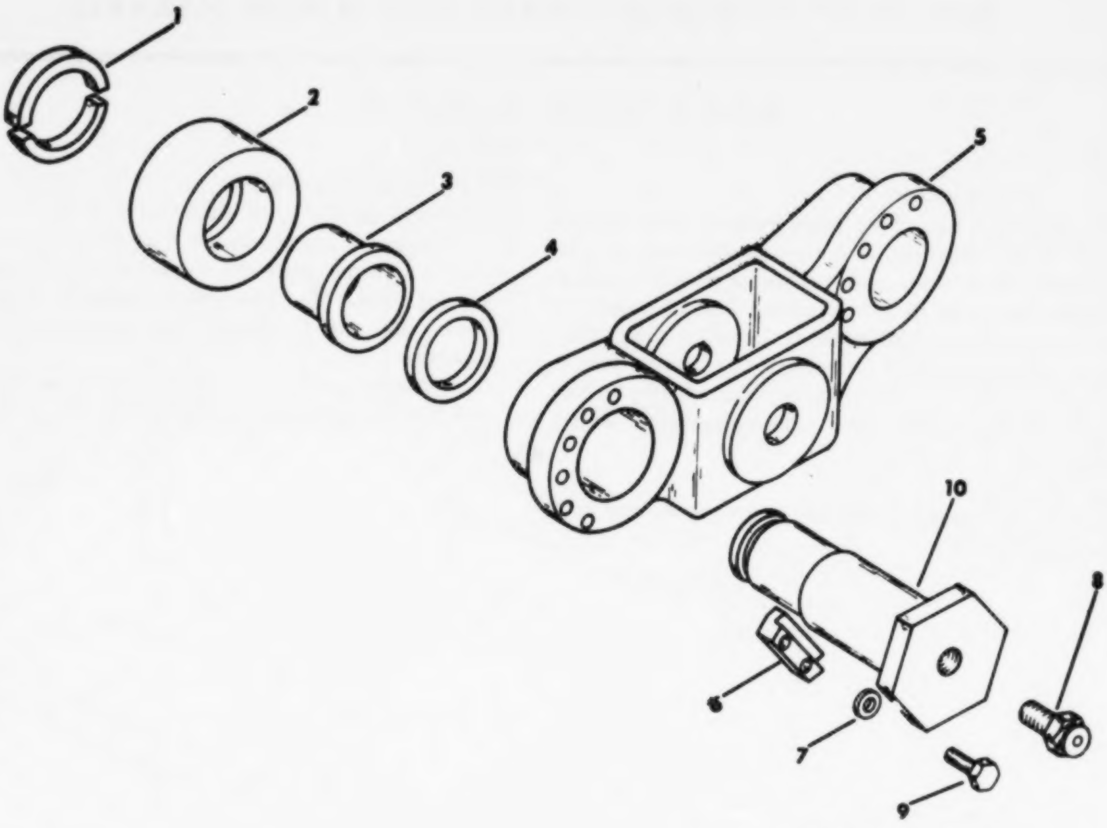
Refer to paragraph 2-18 and remove front and rear hook rollers.

8-3. Disassembly

Disassemble the hook roller as follows:

a. Remove capscrews (9, fig. 8-1), lockwashers (7), and keeper plate (6). Press hook roller pin (10) toward roller (2). Then slide roller(2) back onto hook roller pin (10) until split washer (1) can be removed.

b. Remove roller (2) from hook roller pin (10) and remove bushing (3) and spacer (4) from roller (2).



ME 3810-288-35/5-19

1. Split washer
2. Roller
3. Bushing
4. Spacer
5. Bracket
6. Keeper plate
7. Lockwasher
8. Grease fitting
9. Capscrew
10. Hook roller pin

Figure 8-1. Hook roller assembly exploded view.

8-4. Cleaning, Inspection, and Repair

Clean all the hook roller parts in an approved cleaning solvent and allow to dry. Inspect roller, bushing, and hook roller pin for scoring, galling, excessive wear, and roundness. Inspect all other parts for excessive wear or distortion. Replace any part which is excessively worn or damaged.

8-5. Reassembly

Refer to figure 8-1 and reassemble the hook roller as follows:

a. Install bushing (3) in roller (2). Install hook roller pin (10) in bracket (5), and install spacer (4) on hook roller pin (10).

b. Install roller (2) on hook roller pin (10) and press roller onto the pin until split washer (1) can be installed in the groove in the hook roller pin. Slide roller over the split washer to hold it in place. Slide hook roller pin and roller toward the keeper plate end.

8-6. Installation

Refer to TM 5-3810-294-20 and install and adjust the hook rollers.

Section II. REPAIR OF BATTERY CABLES, SUPPRESSION LEADS, AND WIRING HARNESS

8-7. Inspection and Repair of Battery Cables

a. Inspection. Inspect the battery cables for worn or frayed insulation, cuts in the cables, or loose or broken connecting lugs.

b. Repair. Worn or frayed insulation can be repaired by covering the worn area with a suitable electrical tape. If battery cables are cut, or broken wires are apparent in the cable, the entire cable must be replaced. If the cables are in good condition and the connecting lugs are broken, repair the cable by removing the connecting lug, cleaning the wires, and crimping a new connecting lug on the end of the cable.

8-8. Inspection and Repair of Wiring Harness and Supression Leads

Refer to TM 5-3810-294-20 for inspection and repair procedures of wiring harness and supression leads.

CHAPTER 9

REPAIR OF CRANE GANTRY AND BOOM COMPONENTS

Section I. REPAIR OF GANTRY

9-1. Description

The gantry is the main structural load bearing member of the attachment. As such, it must be inspected more carefully than most other assemblies of this machine. It is particularly important that the gantry be inspected carefully after any incident involving severe snapping, whipping, or jerking of the boom, due to any cause. Any visual indication of twisted, broken, deformed, cracked or damaged gantry parts should be thoroughly investigated by non-destructive test methods. It is recommended that the inspection be made by the magnetic particle (Magnaflux) method, if possible. Worn or damaged parts, including sheaves and sheave bushings, should always be replaced.

9-2. Repair Procedure

Refer to figure 9-1 and replace any worn or damaged gantry part. Sheaves may be repaired as instructed in paragraph 9-10.

KEY to fig. 9-1.

1. Link (2)
2. Peak pin
3. Grease fitting (2)
4. Lower spreader frame
5. Capscrew (2)
6. Cotter pin (2)
7. Pin
8. Cotter pin (2)
9. Sheave (2)
10. Bushing (2)
11. Sheave (2)
12. Bushing (2)
13. Wedge
14. Link
15. Cotter pin (2)
16. Pin
17. Rope Socket
18. Grease fitting (4)
19. Pin (2)
20. Pin (2)
21. Lockwasher (2)
22. Nut (2)
23. Eye bolt
24. Lockwasher
25. Capscrew
26. Pin
27. Grease fitting (2)
28. Cotter pin (4)
29. Pin (2)
30. Bushing (2)
31. Gantry member (2)
32. Bushing
33. Sheave
34. Front gantry member

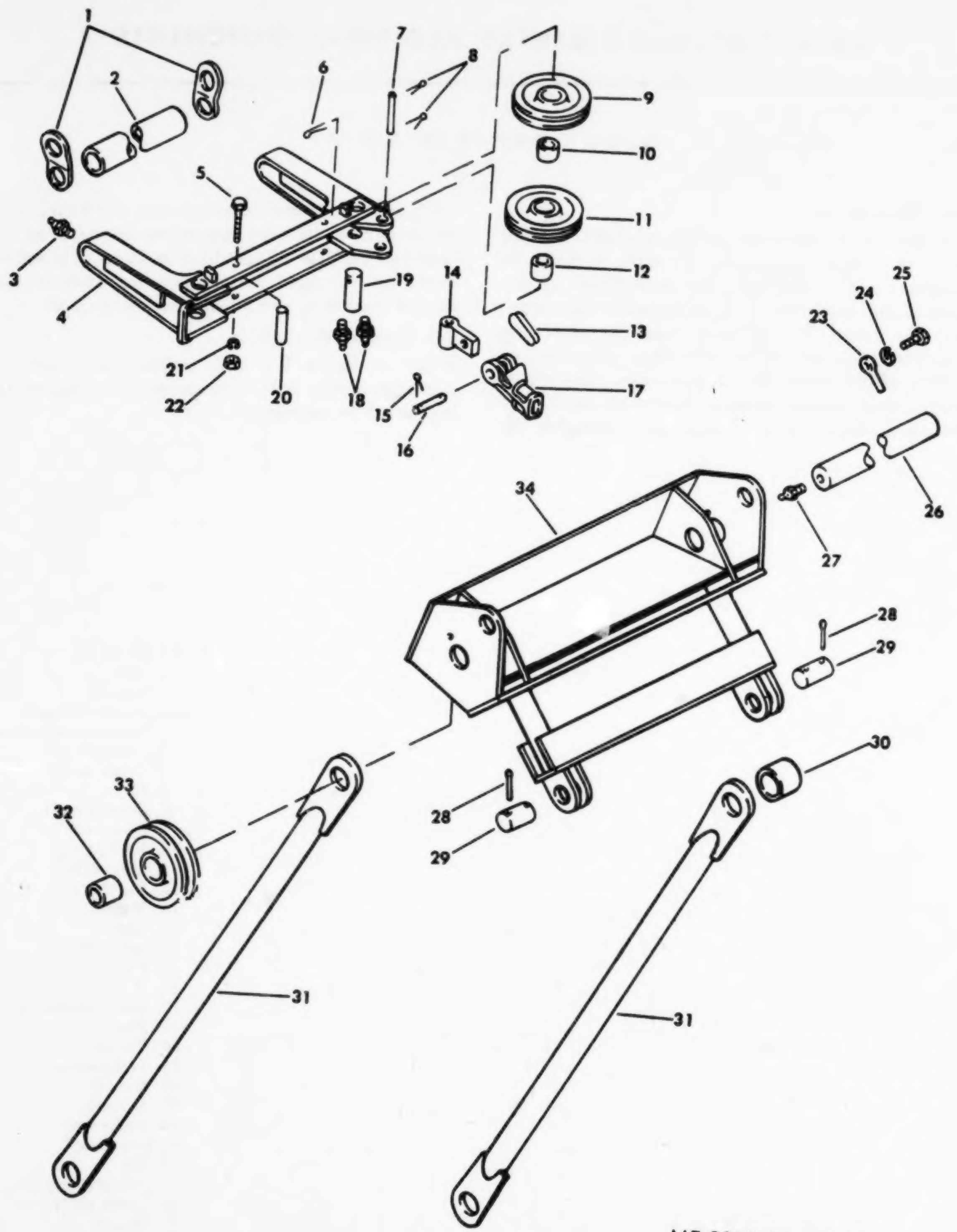

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
31
32
33
34
ME 3810-288-35/5-16

Figure 9-1. Gantry assembly exploded view.

Section II. REPAIR OF HOOK BLOCK

9-3. Description

The hook block supports the load in crane applications. It is imperative that the hook block be properly lubricated and inspected as described in the follow paragraphs.

9-4. Removal

To remove the hook block, lower the hook block to the ground, disconnect the hoist cable at the dead end (which may be at the hook block or on the boom point, depending on the number of parts of line involved) and unreave the hoist line from the hook block.

9-5. Disassembly

Disassemble the hook block as follows:

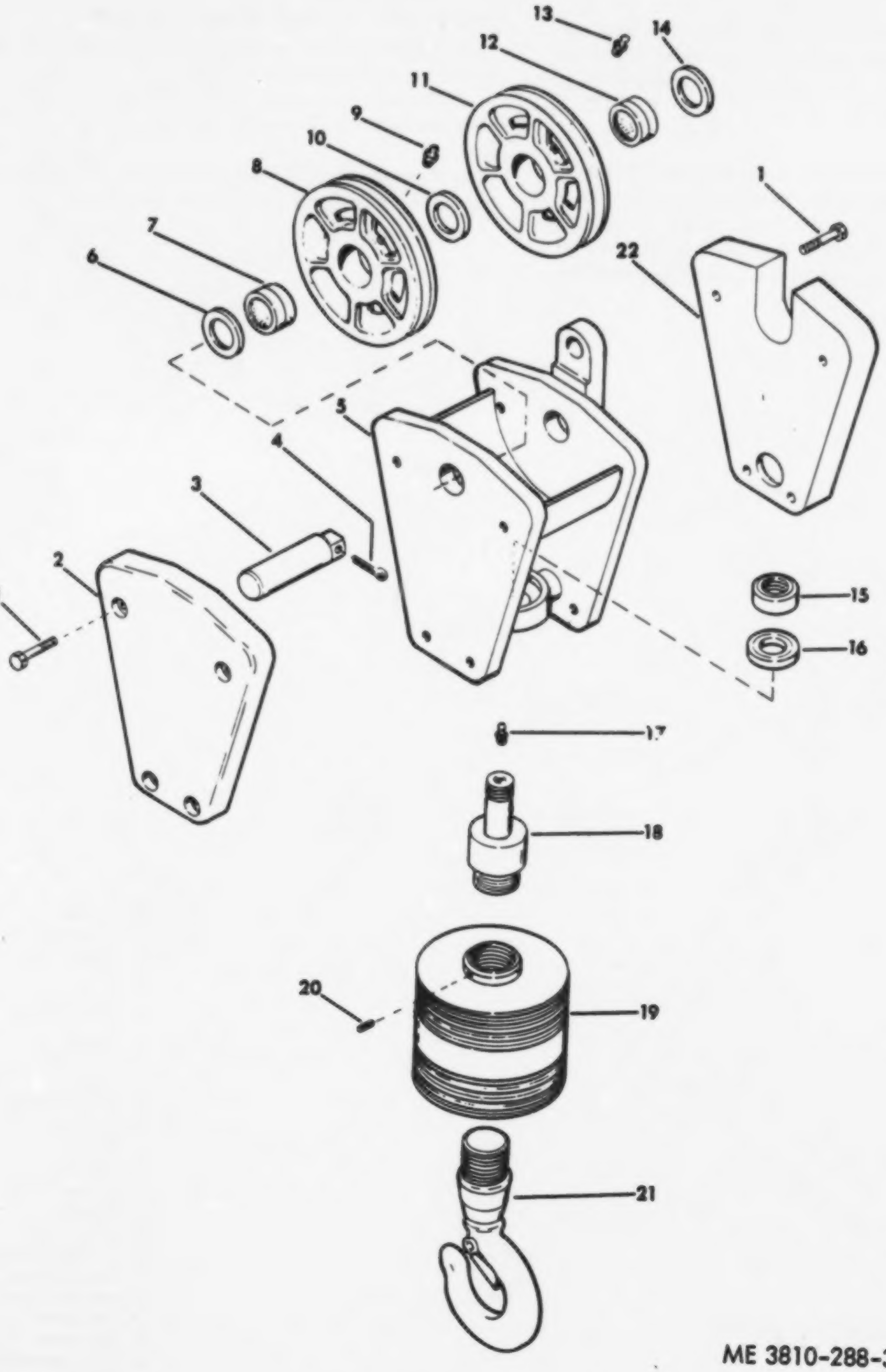
a. Remove cheek plates (2 and 22, fig. 9-2) by removing capscrews (1).

b. Remove cotter pin (4) and press pin (3) out of sheave block (5). Items (6 through 14) will now be free.

c. Remove nut (15), set screw (20), and unscrew stud (18) and hook (21) from insulator (19).

KEY to fig. 9-2.

1. Capscrew (8)
2. Cheek plate
3. Pin
4. Cotter pin
5. Sheave block
6. Spacer
7. Bearing
8. Sheave
9. Grease fitting
10. Spacer
11. Sheave
12. Bearing
13. Grease fitting
14. Spacer
15. Round nut
16. Thrust bearing
17. Grease fitting
18. Shoulder stud
19. Insulator
20. Set screw
21. Hook assembly
22. RH Cheek plate


13
14
12
11
9
10
8
1
22
7
6
5
4
3
2
1
15
16
17
18
20
19
21

ME 3810-288-35/5-17

Figure 9-2. Hook block exploded view.

9-6. Inspection and Repair

a. Clean all parts using a suitable solvent before inspecting for wear or damage.

b. Inspect grease fittings for wear or damaged threads and replace damaged grease fittings.

c. Inspect hook assembly (21, fig. 9-2) for any indication of cracks. The magnetic particle (Magnaflux) or other suitable crack testing inspection method should be used. No cracks are permissible. Also, inspect the hook for increase of throat diameter or bending, as compared with a new hook. A 15 percent increase in throat opening, or a 10 percent side bend is considered adequate reason to replace the hook assembly.

d. Inspect all threaded items for thread damage, pins for distortion, cracks, excessive wear, and bearings for wear scoring, or visible signs of damage. Replace all such parts.

e. Inspect sheaves (8 and 11) for wear or signs of cracking. Repair or replace a damaged or worn sheave.

f. Replace insulator (19) if signs of damage are apparent.

9-7. Reassembly

a. Install hook (21, fig. 9-2) in insulator (19).

b. Install shoulder stud (18) in insulator (19) and secure with set screw (20).

c. Install grease fitting (17), insert subassembled hook-insulator assembly in hole in the bottom of sheave block (5), and install thrust bearing (16) and round nut (15).

d. Install bearings (7 and 12) in sheaves (8 and 11). Block sheaves and spacers (6, 10, and 14) in position in sheave block (5) and press pin (3) through assembled sheave bearings and spacers. Install cotter pin (4).

e. Install cheek plates (2 and 22) and capscrews (1).

f. Lubricate assembly with type GAA lubricant before returning to service.

g. Make sure that all sheave bearings allow the sheaves to turn freely. If a sheave binds on a sheave pin, the wire rope will drag through the sheave groove and damage the sheave and wire.

h. Clean up rough or burred edges on sheaves with a fine file.

9-8. Installation

Refer to TM 5-3810-294-10 and install the hook block.

Section III. REPAIR OF SHEAVES AND BOOM ROLLERS

9-9. Description

Sheaves provide low friction pivot points for load cable movement. Boom rollers assist in guiding the cable and prevent friction contact with the boom. Sheaves vary in size and application, however, maintenance is similar for all sheaves. The only possible repair that can be made to boom rollers is to replace them when they are excessively worn or damaged.

9-10. Cleaning, Inspection, and Repair

Clean sheaves with cleaning solvent and wipe dry, removing all old lubricant. Inspect hub bushing for excessive wear and replace if necessary. Inspect lubrication fitting and make sure that passages are open and have been receiving adequate lubricant. Examine the sheave groove for excessive wear. A properly grooved sheave has smooth side walls and the groove is only slightly wider than the cable that passes over it. Worn or corrugated grooves chafe and wear cables. Grooves may be smoothed on a lathe if corrugations are not too deep. Any cracks in the body should be welded, ground, and checked for warpage.

9-11. Installation

Before sheaves are installed, the sheave shaft or pin should be cleaned of all corrosion and paint. The inside of the bushing and the shaft should be coated with a thin layer of lubricant. The lubrication fitting should be properly positioned during installation. Make sure that all sheave bearings allow the sheaves to turn freely. If a sheave binds on a sheave pin, the cable will drag through the sheave groove and damage the sheave and cable.

Section IV. REPAIR OF CRANE, DRAGLINE, AND CLAMSHELL BOOM

9-12. Repair

Sheave and cable roller repair is covered in paragraph 9-10. Additional repair of the boom attachment is welding of damaged boom structural members. The boom welds must be inspected carefully; the magnetic particle (Magnaflux) method is recommended. Any cracked boom, defective welds, or defective structural members must be repaired by welding or replaced.

Warning: Boom repairs or alterations of any kind are a delicate and skilled operation. Boom welding must be performed only by a thoroughly trained and skilled welder trained in boom repair. Any indication of structural failure of any boom component should be cause for considering replacing the boom section rather than repairing it. The maintenance officer in charge must make this decision.

9-13. Replacement

Refer to TM 5-3810-294-10 for crane boom replacement procedures.

Section V. REPAIR OF SHOVEL AND BACKHOE ATTACHMENT

9-14. Repair of Shovel Dipper Stick

Sheave repair is covered in paragraph 9-10. If severe wear is observed on the dipper stick of the shovel attachment, this condition can be repaired. When adjusting shovel saddle block to wear plate clearance as described in TM 5-3810-294-10, the thickness of the dipper stick is measured at three points, the upper third, the middle third, and the lower third of the dipper stick. If there is a difference of more than 3 / 64 inch in the thickness of the dipper stick at the three points measured, the dipper stick should be replaced or repaired. To repair, build up the low spots with stainless steel weld and grind the stick back to uniform dimensions.

9-15. Repair of Shovel and Backhoe Attachments

If cracks are noted in the shovel front or the backhoe front attachment main members, they may be repaired as follows:

a. Drill a hole at the ends of the crack to stop further cracking from proceeding down the boom.

b. Repair the crack by welding, being careful to make sure that the correct type of weld rod and welding procedures are used.

c. Replace the component if the crack has extended into the boom foot pin bore, or other vital load bearing areas.

9-16. Replacement

Refer to TM 5-3810-294-10 for shovel and backhoe attachment replacement procedures.

Section VI. REPAIR OF FAIRLEAD ASSEMBLY

9-17. Description

The fairlead provides a straight line pull to the dragline bucket. It is reaved from the bottom of the front drum to the drag bucket.

9-18. Removal

Refer to TM 5-3810-294-10 and remove the fairlead assembly.

9-19. Cleaning, Inspection, and Replacement

Sheave repair is covered in paragraph 9-10. Always clean all parts with a suitable solvent before inspection or repairs are attempted. Refer to figure 9-3 and replace any damaged or excessively worn part of the fairlead.

KEY to fig. 9-3.
1. Washer (2)
2. Roller guide bearing (2)
3. Guide roller (2)
4. Roller guide bearing (2)
5. Washer (2)
6. Capscrew
7. U-bolt (2)
8. Cross tube shim (4)
9. Lockwasher (4)
10. Nut (4)
11. Grease fitting (4)
12. Roller shaft (2)
13. Nut
14. Sheave shaft bearing (4)
15. Grease fitting (4)
16. Key (2)
17. Sheave shaft (2)
18. Sheave (2)
19. Cross tube
20. U-bolt (2)
21. Nut (4)
22. Washer (4)
23. Lockwasher (8)
24. Capscrew (8)
25. Housing

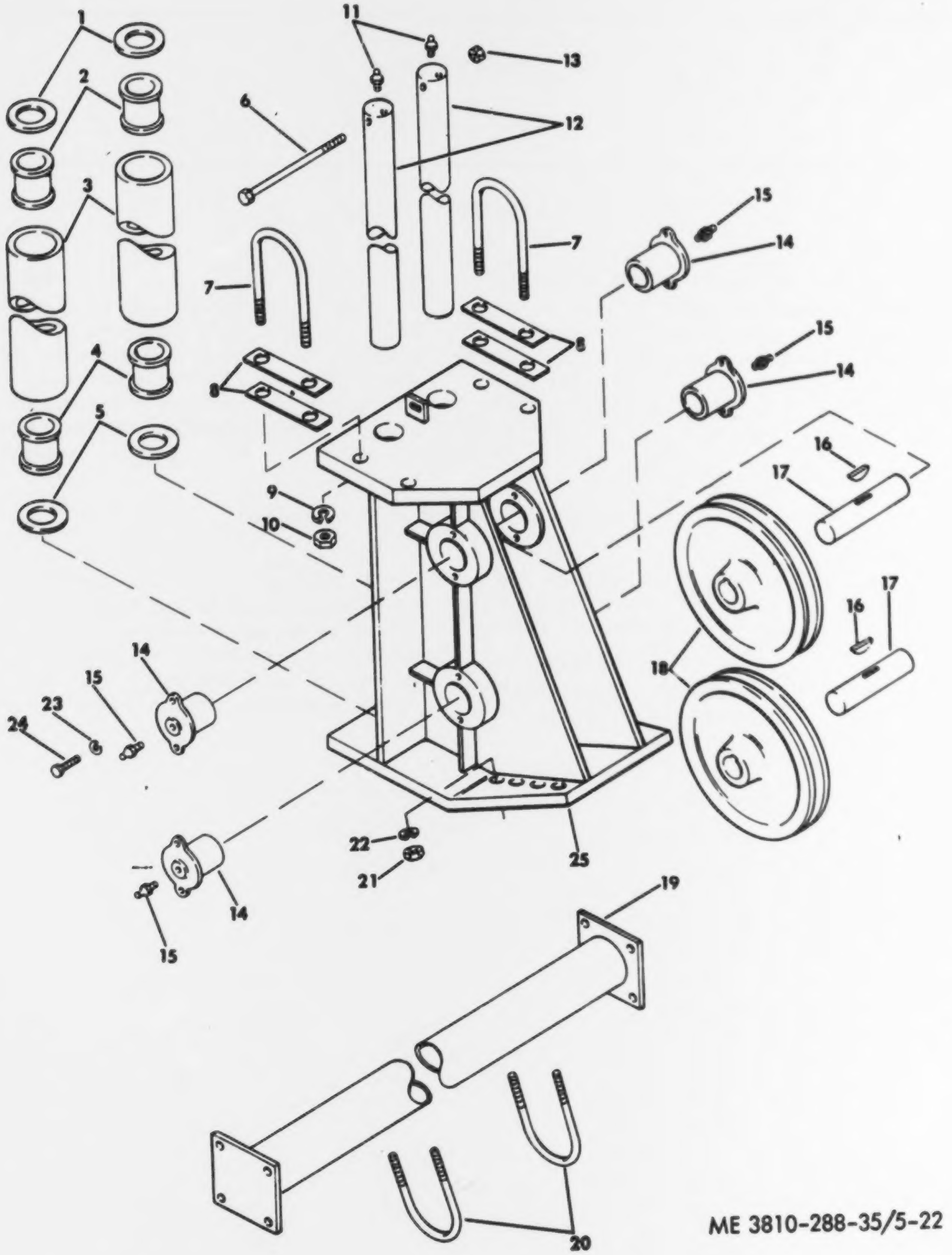

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
ME 3810-288-35/5-22

Figure 9-3. Fairlead assembly exploded view.

PART TWO

CARRIER

CHAPTER 10

INTRODUCTION

Section I. GENERAL

10-1. Scope

a. This part of the manual covers repair instructions for the carrier portion of the model M320T2 truck crane. Maintenance personnel should read the instructions provided in both parts of this manual before repairing the equipment.

b. Refer to chapter 1 for instructions about using this manual.

10-2. Forms and Records

Refer to chapter 1 for information concerning maintenance records and reports. Instructions for direct reporting of errors, omissions, and recommendations for improving this equipment publication by the individual use are also covered in chapter 1.

Section II. DESCRIPTION AND DATA

10-3. Description

a. A general description of the model M320T2 truck crane and information pertaining to the identification plates are contained in TM 5-3810-294-10 and TM 5-3810-294-20. Equipment operating instructions are also contained in TM 5-3810-294-10.

b. A detailed description of specific components and assemblies is contained, as applicable, in the maintenance sections of this manual.

10-4. Tabulated Data

Refer to chapter 1 for all tabulated data about the model M320T2 truck crane.

CHAPTER 11

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

11-1. Special Tools and Equipment

No special tools or equipment are required to perform Direct Support or General Support maintenance on the model M320T2 truck crane carrier.

11-2. Specially Designed (Fabricated) Tools and Equipment

No specially designed (fabricated) tools or equipment are required to perform Direct Support or General Support maintenance on the model M320T2 truck crane carrier.

Section II. TROUBLESHOOTING

11-3. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the model M320T2 truck crane carrier and its components. Probable malfunctions are listed in table 2-1. Each malfunction is followed by a list of probable causes. Recommended corrective action is described opposite the probable cause.

11-4. Troubleshooting

Refer to table 2-1 and troubleshoot the model M320T2 truck crane carrier.

Section III. GENERAL MAINTENANCE

11-5. General

General maintenance are discussed in Chapter 2 (para 2-5 through 2-9). Refer to these paragraphs for any general maintenance instructions.

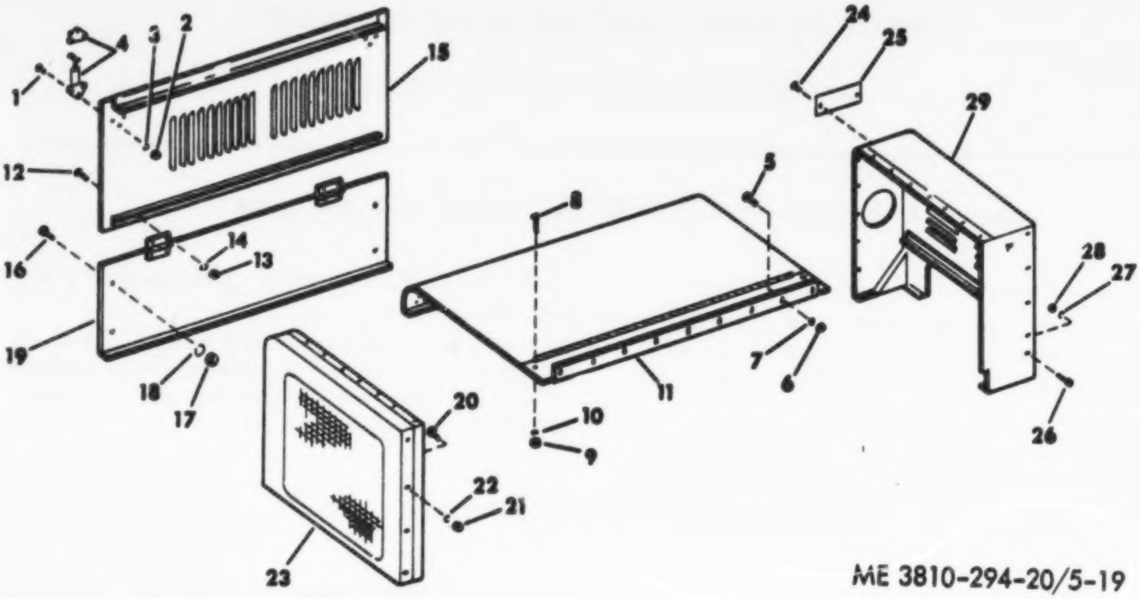
Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

11-6. General

Removal and installation of major components of the model M320T2 truck crane carrier are discussed in the following paragraphs.

11-7. Cab Assembly

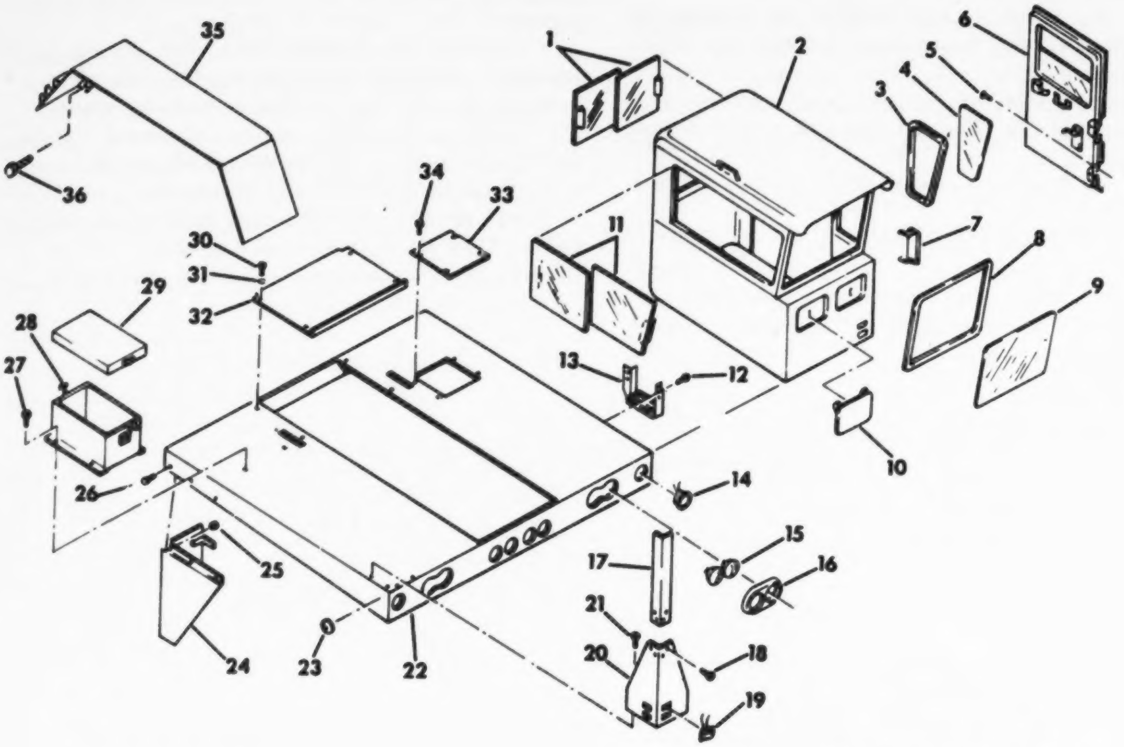
Refer to figure 11-1, and remove and install cab assembly components as necessary for repair.



4
3
2
1
15
24
25
29
12
5
8
16
14
13
28
27
19
7
6
11
18
17
20
10
9
26
22
21
23
ME 3810-294-20/5-19

1. Machine screw (12)
2. Nut (12)
3. Lockwasher (12)
4. Fastener assembly (2)
5. Capscrew (2)
6. Nut (5)
7. Lockwasher (5)
8. Machine screw (2)
9. Nut (5)
10. Lockwasher (2)
11. Top panel (1)
12. Capscrew (12)
13. Nut (4)
14. Lockwasher (4)
15. Upper side panel (1)
16. Machine screw (4)
17. Nut (4)
18. Lockwasher (4)
19. Lower side panel (1)
20. Capscrew (9)
21. Nut (9)
22. Lockwasher (9)
23. Center front rail (1)
24. Screw (2)
25. Information plate (1)
26. Capscrew (5)
27. Lockwasher (5)
28. Nut (5)
29. Rear panel (1)

Figure 11-1. Carrier cab assembly, exploded view. (Sheet 1 of 2)



1. Window, rear
2. Cab
3. Weatherstripping
4. Window
5. Capscrew
6. Door assembly
7. Vent door
8. Weatherstripping
9. Window
10. Vent door
11. Window
12. Capscrew
13. Ladder bracket
14. Park and directional lamp
15. Headlight
16. Headlamp door
17. Mirror stand
18. Capscrew
19. Running and blackout lights
20. Mirror mounting base
21. Capscrew
22. Platform
23. Reflector
24. Platform skirt
25. Nut
26. Capscrew
27. Capscrew
28. Battery box
29. Cover
30. Capscrew
31. Lockwasher
32. Access cover
33. Seat mounting bracket
34. Capscrew
35. Rear fender
36. Capscrew

Figure 11-1. Carrier cab assembly, exploded view (Sheet 2 of 2).

11-8. Engine

a. General. It is easier to remove the engine with the transmission attached than it is to remove it without the transmission. This procedure assumes that the engine and transmission are to be removed as an assembly.

b. Removal.

(1) Refer to figure 11-1 ① and remove all parts shown.

(2) Refer to figure 11-1 ② and remove access cover (32) and attaching hardware (30 and 31).

(3) Refer to TM 5-3810-294-20 and perform the following operations.

(a) Drain cooling system and remove oil filter, muffler, and disconnect front propeller shaft. See figure 11-2.

(b) Disconnect battery cables and necessary wiring. Tag all electrical leads before disconnecting.

(c) Remove radiator. Refer to TM 5-3810-294-20.

(d) Drain engine crankcase.

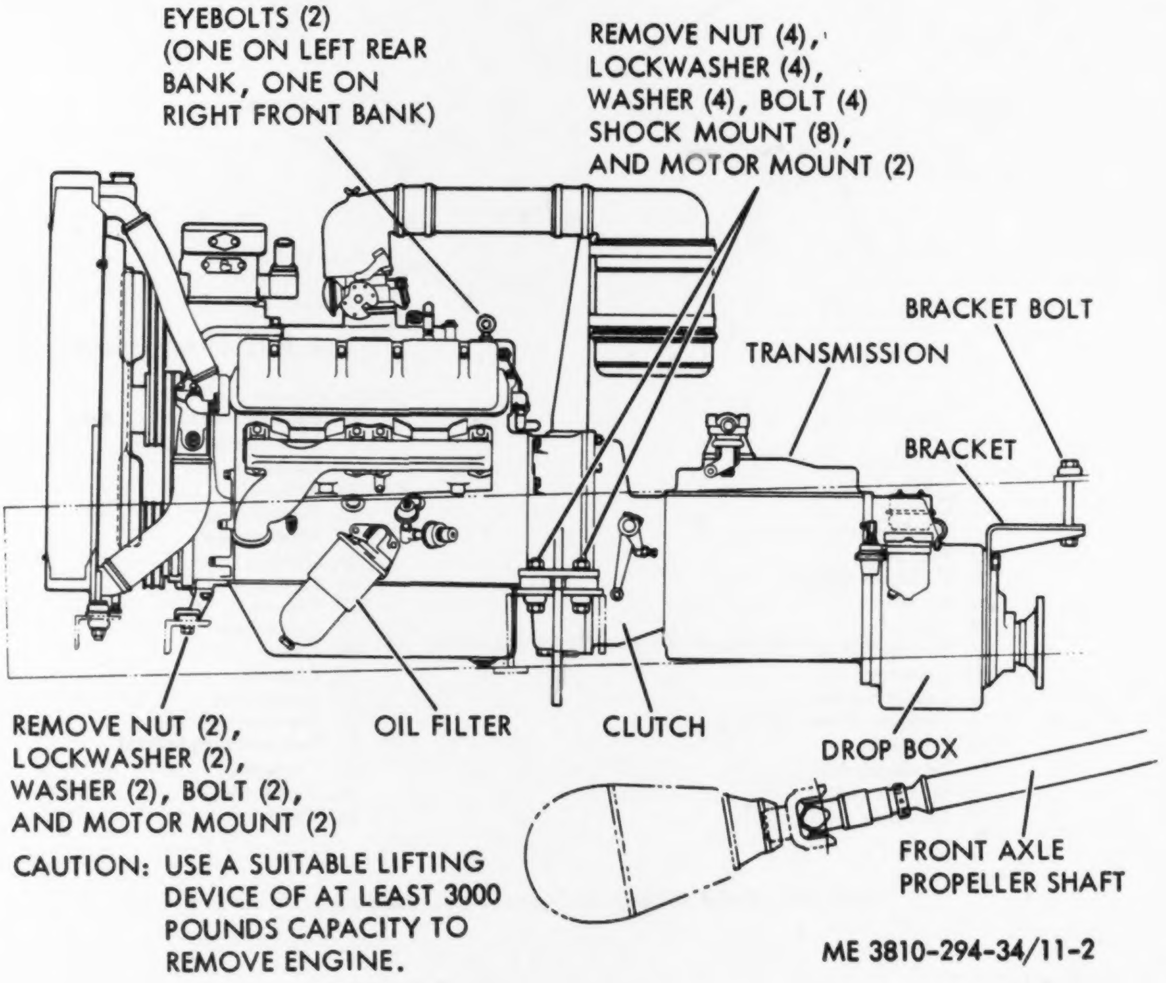
(e) Disconnect accelerator linkage, tachometer cable and transmission shift levers.

(f) Disconnect fuel, air, hydraulic, and oil lines from the engine.

(g) Disconnect exhaust pipe from engine manifolds, and air cleaner hose from air compressor.

(3) Remove springs, hoses, and wiring harnesses that may interfere with engine removal from holding clips or clamps attached to the engine.

(4) Refer to figure 11-2 and remove engine and transmission as a unit. Attach sling with hooks to eyebolts on engine, make certain that the chain or hooks do not crush lines or damage the alternator. Take the slack out of the chain. Attach a sling to the transmission to balance the unit.


EYEBOLTS (2) (ONE ON LEFT REAR BANK, ONE ON RIGHT FRONT BANK)
REMOVE NUT (4), LOCKWASHER (4), WASHER (4), BOLT (4) SHOCK MOUNT (8), AND MOTOR MOUNT (2)
BRACKET BOLT
TRANSMISSION
BRACKET
REMOVE NUT (2), LOCKWASHER (2), WASHER (2), BOLT (2), AND MOTOR MOUNT (2)
OIL FILTER
CLUTCH
DROP BOX
FRONT AXLE PROPELLER SHAFT
ME 3810-294-34/11-2

CAUTION: USE A SUITABLE LIFTING DEVICE OF AT LEAST 3000 POUNDS CAPACITY TO REMOVE ENGINE.

Figure 11-2. Engine removal and installation.

b. Installation.

(1) If clutch controls were removed, refer to paragraph 14-4 for installation instructions.

(2) Refer to figure 11-2 and install the engine.

(3) Assemble springs, hoses and lines that were removed for engine removal to holding clips or clamps attached to the engine.

(4) Refer to TM 5-3810-294-20 and perform the following operations.

(a) Connect exhaust pipe to engine manifold and air cleaner hose to air compressor.

(b) Connect the fuel, air, hydraulic, and oil lines to the engine.

(c) Connect accelerator linkage, tachometer cable, and transmission shift levers.

(d) Install radiator.

(e) Connect battery cables and electrical leads.

(f) Fill engine crankcase with lubricant specified in the current LO.

(g) Fill cooling system.

(5) Service engine in accordance with TM 5-3810-294-20 before placing engine in operation.

11-9. Transmission Assembly

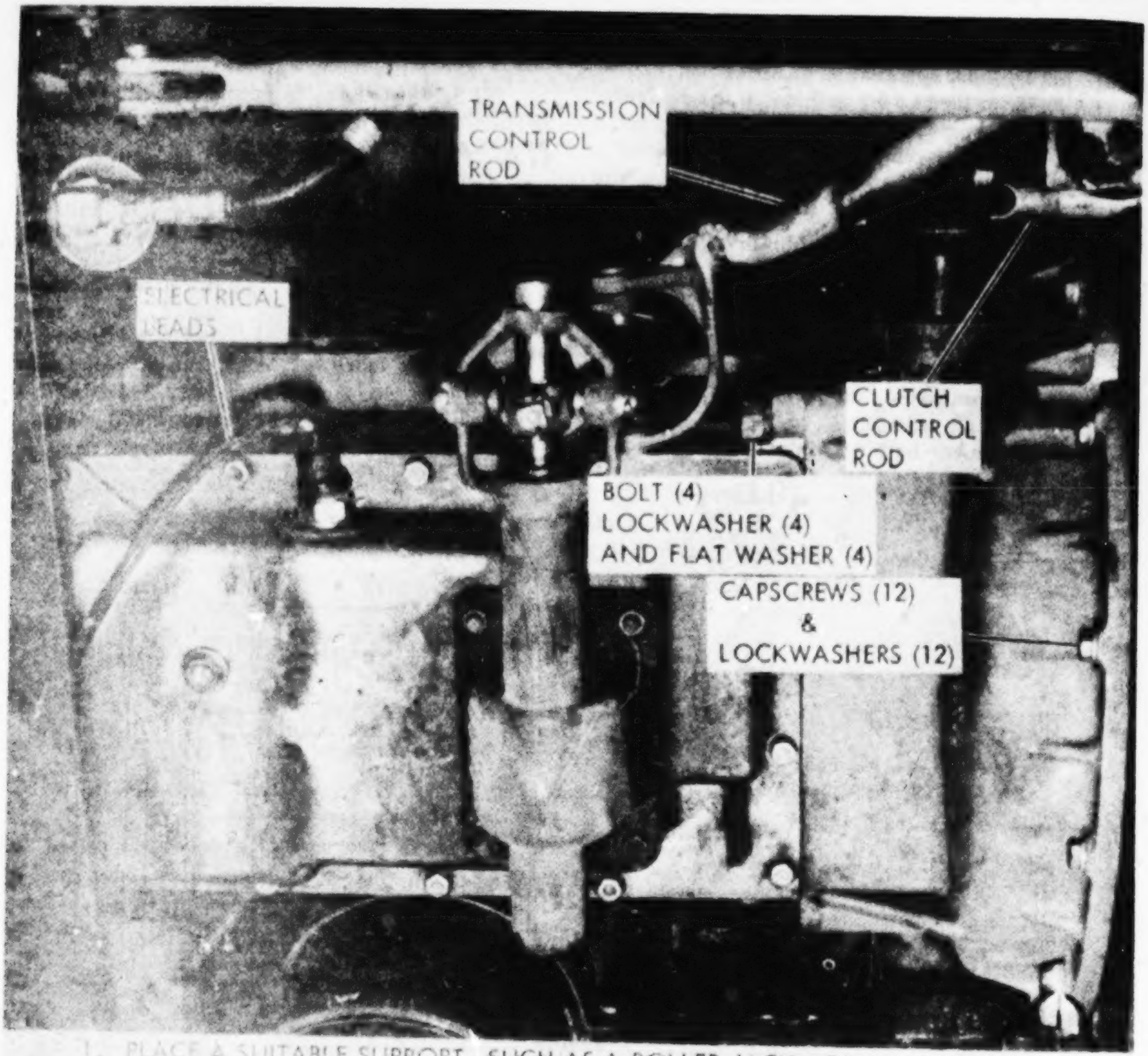
a. Removal.

(1) Remove four bolts, lockwashers, and flat washers that secure transmission cover. Remove cover.

(2) Disconnect front propeller shaft from drop gear unit, and completely remove front axle propeller shaft (refer to TM 5-3810-294-20).

(3) Drain lubricant from transmission and drop gear unit (refer to TM 5-3810-294-20).

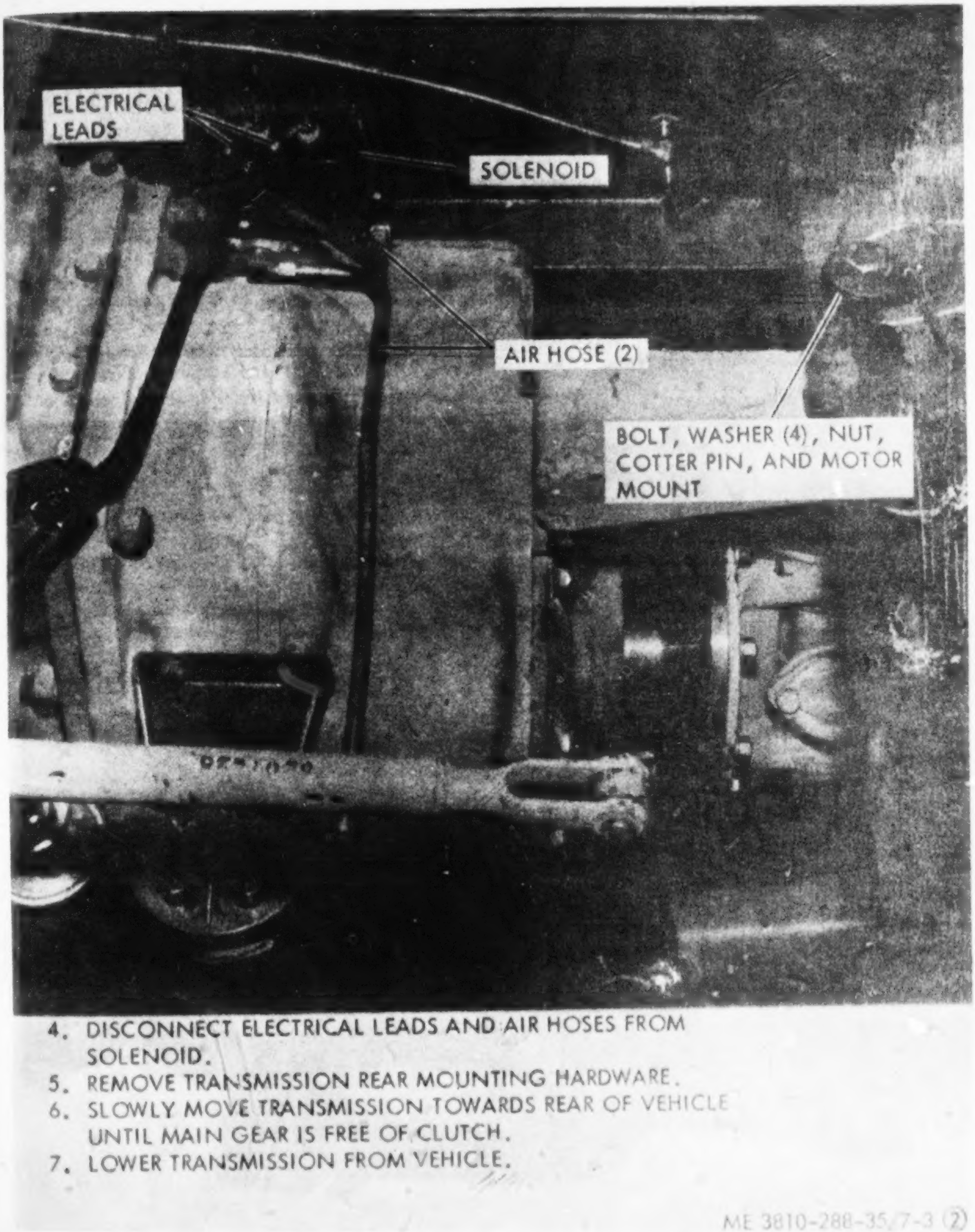
(4) Refer to figure 11-3 and install transmission assembly.


TRANSMISSION CONTROL ROD
ELECTRICAL LEADS
CLUTCH CONTROL ROD
BOLT (4) LOCKWASHER (4) AND FLAT WASHER (4)
CAPSCREWS (12) & LOCKWASHERS (12)

1. PLACE A SUITABLE SUPPORT, SUCH AS A ROLLER JACK, OF AT LEAST 2000 POUNDS CAPACITY UNDER THE TRANSMISSION.
2. DISCONNECT ELECTRICAL LEADS, TRANSMISSION ROD, AND CLUTCH CONTROL ROD.
3. REMOVE TRANSMISSION-TO-FLYWHEEL CAPSCREWS AND LOCKWASHERS.

ME 3810-288-35/7-3 ①

Figure 11-3. Transmission assembly, removal and installation. (Sheet 1 of 2).


ELECTRICAL LEADS
SOLENOID
AIR HOSE (2)
BOLT, WASHER (4), NUT, COTTER PIN, AND MOTOR MOUNT

4. DISCONNECT ELECTRICAL LEADS AND AIR HOSES FROM SOLENOID.
5. REMOVE TRANSMISSION REAR MOUNTING HARDWARE.
6. SLOWLY MOVE TRANSMISSION TOWARDS REAR OF VEHICLE UNTIL MAIN GEAR IS FREE OF CLUTCH.
7. LOWER TRANSMISSION FROM VEHICLE.

ME 3810-288-35/7-3 ②

Figure 11-3. Transmission assembly, removal and installation. (Sheet 2 of 2).

b. Installation.

(1) Refer to figure 11-3 and install transmission assembly.

Note. Center clutch in flywheel housing using a dummy shaft or clutch installation tool shaft of the same diameter as the transmission input shaft. If a spare transmission input shaft is available, this would also serve to center the clutch (para 14-17). Move the transmission forward and enter the input shaft into the clutch bore.

(2) Connect front propeller shaft to drop gear unit, and install front axle propeller shaft (refer to TM 5-3810-294-20).

(3) Fill transmission and drop gear unit with lubricant specified in the lubrication chart (refer to TM 5-3810-294-20).

(4) Install transmission cover and secure with four flat washers, lockwashers and bolts.

(5) Adjust clutch control linkage (refer to TM 5-3810-294-20).

11-10. Transfer Case

a. Removal

(1) Refer to TM 5-3810-294-20 and perform the following operations:

(a) Disconnect front front axle, and intermediate propeller shafts from transfer case.

(b) Disconnect transfer case controls from transfer case.

(c) Drain lubricant from transfer case.

(2) Place a roller jack or similar support under transfer case.

(3) Refer to figure 11-4 and remove transfer case.

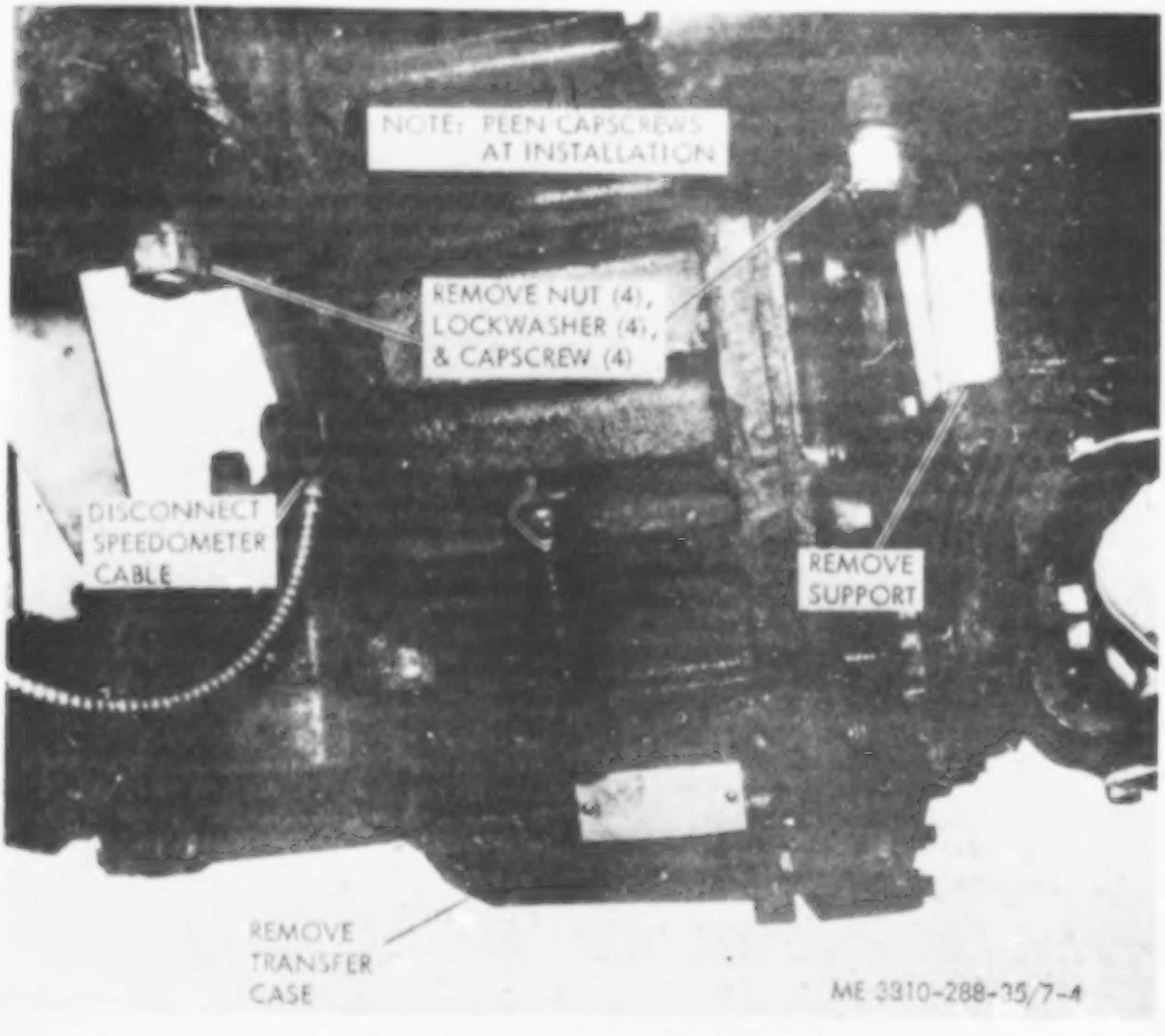

NOTE: PEEN CAPSCREWS AT INSTALLATION
REMOVE NUT (4), LOCKWASHER (4), & CAPSCREW (4)
DISCONNECT SPEEDOMETER CABLE
REMOVE SUPPORT
REMOVE TRANSFER CASE
ME 3810-288-35/7-4

Figure 11-4. Transfer case, removal and installation.

b. Installation.

(1) Refer to figure 11-4 and install transfer case.

(2) Refer to TM 5-3810-294-20 and perform the following operations.

(a) Connect transfer case controls.

(b) Connect front, front axle, and intermediate propeller shafts.

(c) Fill transfer case with lubricant specified in the current LO.

11-11. Front Axle and Spring Assembly

a. Removal.

(1) Disconnect air lines from front brake chambers.

(2) Disconnect drag link from steering arm (refer to TM 5-3810-294-2C).

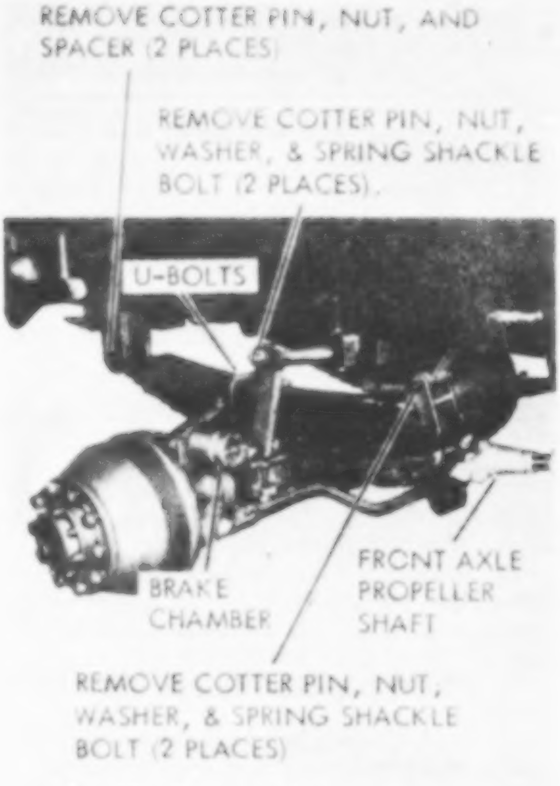
(3) Attach a suitable hoist to front of carrier, lift carrier and block in raised position. Place a suitable floor jack under center of axle housing.

(4) Disconnect front axle propeller shaft (refer to TM 5-3810-294-20).

(5) Remove shock absorbers (refer to TM 5-3810-294-20).

(6) Remove steering mechanism (refer to para. 16-2).

(7) Refer to figure 11-5 and remove the front axle and spring assembly.


REMOVE COTTER PIN, NUT, AND SPACER (2 PLACES)
REMOVE COTTER PIN, NUT, WASHER, & SPRING SHACKLE BOLT (2 PLACES).
U-BOLTS
BRAKE CHAMBER
FRONT AXLE PROPELLER SHAFT
REMOVE COTTER PIN, NUT, WASHER, & SPRING SHACKLE BOLT (2 PLACES)

1. REMOVE WHEELS. (TM5-3810-294-20
2. REMOVE TORSION BAR.
3. REMOVE FRONT AXLE AND SPRING ASSEMBLY.
4. REMOVE U-BOLTS.

ME 3810-294-34/11-5

Figure 11-5. Front axle and spring assembly, removal and installation.

b. Installation.

(1) Refer to figure 11-5 and install the front axle and spring assembly.

(2) Install shock absorbers (refer to TM 5-3810-294-20).

(3) Connect front axle propeller shaft (refer to TM 5-3810-294-20).

(4) Connect air lines to front brake chambers.

(5) Connect steering link to steering arm (refer to TM 5-3810-294-20).

(6) Remove hoist from front end of carrier.

11-12. Forward-Rear Axle Assembly

a. Removal.

(1) Tag and disconnect air lines from brake chambers, interaxle differential lockout, and air brake system components located on forward-rear axle assembly.

(2) Disconnect intermediate and interaxle propeller shafts from forward-rear axle assembly (refer to TM 5-3810-294-20).

(3) Position a hydraulic jack under the rear carrier frame. Raise the jack until weight of carrier is off the rear axles, but with rear wheels on the ground.

(4) Remove rear wheels (refer to TM 5 3810-294-20).

(5) Place a suitable support under forward-rear axle assembly.

(6) Disconnect torque rods and equalizer beams (fig. 11-6) from both ends of forward-rear axle assembly.

(7) Remove forward-rear axle assembly.

b. Installation.

(1) Position forward-rear axle assembly under carrier.

(2) Connect torque rods and equalizer beams (fig. 7-6) to both ends of forward-rear axle assembly.

(3) Install rear wheels (refer to TM 5-3810-294-20).

(4) Remove hydraulic jack.

(5) Connect intermediate and interaxle propeller shafts to forward-rear axle assembly (refer to TM 5-3810-294-20).

(6) Connect air lines to brake chambers, interaxle differential lockout, and air brake system components located on the forward-rear axle assembly.

(7) Lubricate forward-rear axle assembly in accordance with the current LO.

11-13. Rear-Rear Axle Assembly

a. Removal.

(1) Tag and disconnect air lines from brake chambers and air brake system components located on the rear-rear axle assembly.

(2) Disconnect interaxle propeller shaft from rear-rear axle (refer to TM 5-3810-294-20).

(3) Position a hydraulic jack under the rear carrier frame. Raise the jack until weight of carrier is off the rear axles, but with rear wheels on the ground,

(4) Place a suitable support under rear-rear axle assembly.

(5) Remove rear wheels (refer to TM 5-3810-294-20).

(6) Disconnect torque rods and equalizer beams (fig. 7-6) from both ends of rear-rear axle assembly.

(7) Remove rear-rear axle assembly from carrier.

b. Installation.

(1) Position rear-rear axle assembly under carrier.

(2) Connect torque rods and equalizer beams (fig. 7-6) to both ends of rear-rear axle assembly.

(3) Install rear wheels (refer to TM 5-3810-294-20).

(4) Remove hydraulic jack.

(5) Connect interaxle propeller shaft (refer to TM 5-3810-294-20).

(6) Connect air lines to brake chambers and air brake system components located on rear-rear axle assembly.

(7) Lubricate rear-rear axle assembly in accordance with the current LO.

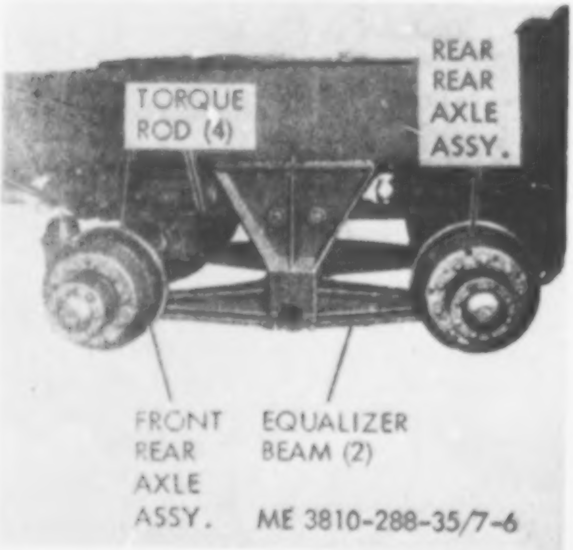


Figure 11-6. Rear axles, removal and installation.

CHAPTER 12

REPAIR OF CARRIER ENGINE ACCESSORIES

Section I. REPAIR OF ALTERNATOR

12-1. General

The alternator is identical to that on the crane engine. Refer to chapter 3 for alternator repair instructions.

Section II. REPAIR OF STARTING MOTOR

12-2. General

Repair of the starting motor is identical to that on the crane engine. Refer to chapter 3 for starting motor repair instructions.

Section III. REPAIR OF DISTRIBUTOR

12-3. Description

The primary function of the distributor is to open and close the circuit between the low voltage source and the ignition coil so that the primary coil winding obtains intermittent surges of current. These surges build up magnetic fields around the primary coil. When the surge stops as the points open, the collapse of the field induces a high voltage surge in the secondary winding, which contains many more turns than the primary. This surge is directed to the spark plug of the cylinder on top center firing stroke to ignite the fuel.

12-4. Removal

Refer to TM 5-3810-294-20 to remove the distributor from the engine.

12-5. Disassembly

Refer to figure 12-1 and disassemble the distributor as follows:

a. Release clamps (1) and lift off cap (2). Drive out pin (3) and remove clamps.

b. Lift out rotor (4) and dust cover (5).

c. Pull the primary cable (11) through the opening. Remove screws (6) and lockwashers (7) and lift out lower plate (8) with breaker parts.

d. Remove nut (9), lockwashers (10) and primary cable (11).

e. Remove screw (12) which secures ground wire (16) to lower plate (8).

f. Remove screw (13), lockwasher (14), condenser (15), and ground wire (16).

g. Remove screw (17), lockwasher (18), nut (19) and point set (20).

h. Remove retaining spring (21). Separate upper and lower plates (8 and 22) and remove nylon buttons (23).

i. Remove wick (24) and retainer (25). Slide cam (26) off shaft and remove slider blocks (27).

j. Remove primary and secondary springs (28 and 29).

k. Remove weight plates (30), bushings (31) and washers (32).

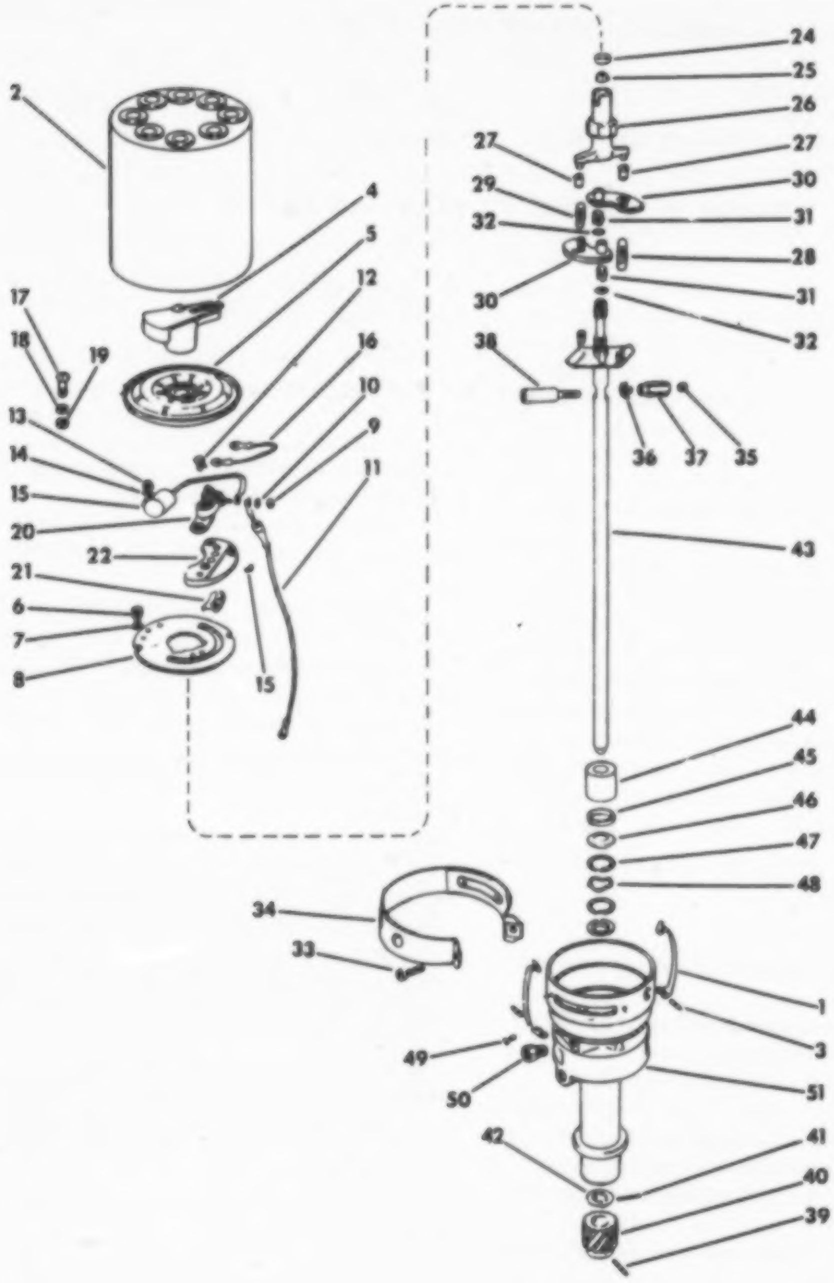
l. Remove screw (33), governor band (34) and plug (35).

m. Bend back tabs on lock plate (36). Place a 7 / 16 inch deep wall socket over governor adjusting tool. With socket over counterweight (37) insert slotted end of tool onto adjusting screw in valve body (38). Hold tool stationary and loosen counterweight until adjusting screw is disengaged. Remove lock plate (36), counterweight (37) and body (38).

n. Drive out pin (39) and press off gear (40). Drive out pin (41) and remove washer (42).

o. Lift shaft (43) out of housing and press out bushing (44), retainer (45), seals (46), washers (47) and spacer (48).

p. Remove plug (49) and adapter (50) from housing (51).


2
4
5
12
16
10
9
11
17
18
19
13
14
15
20
22
21
6
7
8
15
24
25
26
27
27
30
29
31
32
28
30
31
32
38
36
37
35
43
44
45
46
47
48
34
33
1
3
49
50
51
42
41
40
39

ME 3810-294-34/12-1

Figure 12-1. Distributor, exploded view.

KEY to fig. 12-1.

1. Cap clamp (2)
2. Distributor cap
3. Pin (2)
4. Rotor
5. Dust cover
6. Screw (2)
7. Lockwasher (2)
8. Lower plate
9. Nut
10. Lockwasher
11. Primary cable
12. Screw
13. Screw
14. Lockwasher
15. Condenser
16. Ground cable
17. Lock screw
18. Lockwasher
19. Nut
20. Point set
21. Retaining spring
22. Upper plate
23. Nylon button (3)
24. Wick
25. Cam retainer
26. Breaker cam
27. Slider block
28. Secondary spring
29. Primary spring
30. Weight plate
31. Bushing
32. Washer
33. Screw
34. Governor band
35. Valve plug
36. Lock plate
37. Counterweight
38. Valve body
39. Spring pin
40. Drive gear
41. Spring pin
42. Thrust washer
43. Shaft assembly
44. Bushing
45. Seal retainer
46. Seal (2)
47. Washer (2)
48. Spacer
49. Plug
50. Adapter
51. Housing

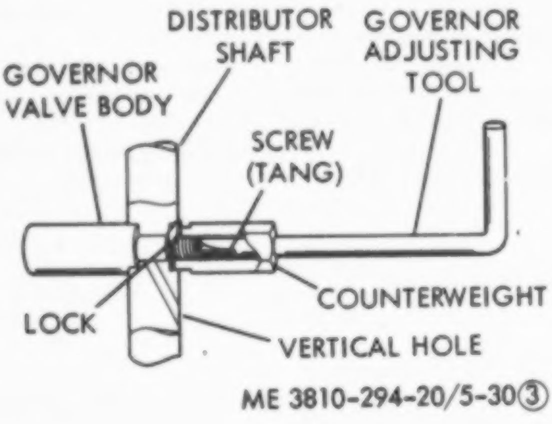


Figure 12-2. Using governor adjusting tool.

12-6. Cleaning

Clean all metal non-electrical parts with dry cleaning solvent (Federal Specification P-S-661) and dry with compressed air. Wipe all other parts clean with a dry cloth.

12-7. Inspection and Repair

a. Replace worn or frayed leads.

b. Replace rotor if cracked or worn.

c. Replace cam if worn or defective.

d. Replace oil wick if hard or dirty.

e. Replace shaft seals. Replace shaft bushing if worn or defective. Replace the seal retainers and washers if dirty. Replace shaft if worn or damaged.

f. Replace point set and condenser.

g. Replace cover if cracked or damaged. Replace weight plate bushings and any part with damaged threads.

12-8. Reassembly and Installation

Refer to figure 12-1 and reassemble the distributor as follows:

a. Slide two seals (46), two washers (47), and a spacer (48) into the housing (51) until they seat on the bottom of the counterbore. Insert seals so the lip in cover seal faces downward and lip in upper seal faces upward.

b. Place retainer (45) in place and press into the housing to a point where the distance from the top of retainer to top edge of housing is 3.615 to 3.617 inches.

c. Install the plug (49) and adapter (50).

d. Place bushing (44) into housing and press bushing to a point where the distance from top of bushing to top of housing is 1-51 / 64 inches.

e. Install bushings (31) and washers (32) on weights plates (30).

f. Lubricate pilot of cam (26) with cam lubricant. Install slider blocks (27), cam (26) and retainer (25) on shaft. Saturate wick (24) with engine oil and install. Install springs (28 and 29).

g. Coat shaft with oil and insert in housing.

h. Install washer (42) and secure with pin (41). Press gear (40) onto shaft to provide an end play clearance of .035 to .040 inch between bottom of housing and top of gear. Install pin (39).

i. Assemble breaker plate assembly as follows.

(1) Install three nylon buttons (23) on upper plate (22) and lubricate with cam lube.

(2) Assemble upper plate to lower plate (8) and secure with spring (21).

(3) Set plates in housing and secure with screws (6) and lockwashers (7).

j. Install condenser (15), and one end of ground wire (16) and secure with screw (13) and lockwasher (14). Attach other end of ground wire to lower plate with screw (12).

k. Install point set (20) on upper plate and secure with screws (17), lockwashers (18) and nuts (19).

l. Insert primary cable (11) into housing and connect condenser lead and cable to point set with nut (9) and lockwasher (10).

m. Install cover (5) and rotor (4).

n. Install governor as follows.

(1) Position a 7 / 16-inch deep wall socket, counterweight (37) and lock plate (36) on governor adjusting tool. (fig. 12-2).

(2) Engage counterweight in socket.

(3) Insert tool in horizontal hole in distributor shaft from side farthest from vertical hole in shaft. Insert governor weight adjusting screw into slotted

end of tool. Withdraw tool and weight assembly through hole in shaft.

(4) Thread counterweight (37) onto valve body (38) while holding tool stationary.

(5) Tighten counterweight to 50-60 inch pounds and bend tabs of lock plate (36) against counterweight. Turn tool clockwise gently to bottom adjusting screw. After bottoming the screw, turn tool counterclockwise 3½ turns.

(6) Install plug (35).

o. Install governor band (34) and secure with a screw (33).

p. Aline the points as follows.

(1) Rotate cam so points are closed. The points must touch through circle around hole in grounded contact.

(2) If contact point is not centered, use needle nose pliers over uprights position of grounded point bracket and bend bracket slightly in or out, or twist it, until contact surfaces touch at center.

q. Adjust the gap as follows.

(1) Place distributor in a vise collet and the collet in a vise.

(2) Loosen screws holding contact bracket to upper plate.

(3) Rotate cam until rubbing block is on highest point of cam lobe. Insert a screwdriver between notch in contact bracket and matching notch in upper plate.

(4) Rotate screwdriver to get proper gap. (table 1-4). Measure gap by inserting a feeler gage between contacts.

(5) Tighten two screws to secure contact bracket.

r. Adjust breaker arm spring tension as follows.

(1) Hook end of spring tension scale calibrated in ounces in end of breaker arm contact and pull in direction perpendicular to plane of contact surfaces. If tension is more or less than specified, loosen both breaker arm spring nuts and shift spring on breaker arm stud to get correct tension.

(2) Tighten nuts and recheck tension.

s. Adjust spark advance as follows.

(1) Mount distributor in a distributor test fixture and set machine to drive distributor at 1500—2000 rpm.

(2) Check the flashes of the rotating disc to see that they occur at 45 degrees intervals. A variation of ± one degree indicates a bent distributor shaft or a worn bushing or cam. Check and replace these parts.

(3) Using a screwdriver adjust the primary spring (29, fig. 12-1) by bending the primary spring post to give the proper advance (table 1-4). (Bending the post away from the shaft decreases advance; bending post toward shaft increases advance). Check and correct adjustment at several points throughout the advance.

t. Attach the clamp (1) to housing and secure with pin (3). Position cap (2) on housing and secure with clamps (1).

u. Install distributor on engine as instructed in TM 5-3810-294-20.

Section IV. REPAIR OF CARBURETOR

12-9. Description

The carburetor is a four barrel concentric downdraft type unit. It differs from other carburetors in that it has two additional or secondary barrels which operate only during periods of heavy engine loads. Throttle plates in the secondary barrel are vacuum operated. The carburetor is similar to the dual concentric type carburetor in that it has two primary barrels each of which contain a venturi, main fuel discharge nozzle, throttle plate, idle passages and choke plate. A throttle operated accelerator pump supplies added fuel for engine acceleration. It also has a power enrichment system which automatically comes into effect whenever an added amount of fuel is needed for full power operation. The governor assembly used is integral with the carburetor and is also vacuum operated.

12-10. Removal

Refer to TM 5-3810-294-20 for instructions to disconnect the fuel lines, controls, linkages, and removal of the carburetor from the engine.

12-11. Disassembly

Refer to figure 12-3 and disassemble the carburetor as follows:

a. Mount carburetor in a holding fixture and secure fixture in vise.

b. Remove screw (1), lockwasher (2) and screen cover (3).

c. Remove screws (4), lockwashers (5), cover (6) and gasket (7). Remove screw (8) and diaphragm (9).

d. Remove screw (10) and tube (11).

e. Use a large screwdriver and remove plug (12) and gasket (13). Remove valve seat (14) and gasket (15) in the same manner.

f. Remove screw (16), clamp (17) and tubes (18).

g. Remove secondary jet tubes (19) and gaskets (20).

h. Remove float shaft (21), float (22) and float spring (23).

i. Remove valve (24) and gasket (25).

j. Remove main jets (26).

k. Use a small screwdriver to remove idle tubes (27).

l. Disconnect accelerator pump linkage and remove stud (28) from rod (29). Remove rod, springs (30 and 31), spring washer (32) and piston (33).

m. Remove rod seal (34), flat washer (35), washers (36), seal (37) and spring (38).

n. Use a fine wire hook to remove valve retainer (39). Remove valve ball (40) and piston cup (41).

o. Remove carburetor from holding fixture and remove main well tubes (42) and needle valve (43).

p. Remove fuel fitting (44), bracket (45), and gaskets (46).

q. Remove screws (48), lockwashers (49) and separate main body (50) and throttle body (51). Retain inlet fitting seal (47) and spacer (52).

r. Cut lock wires (53) and seal (54). Remove screws (55), cover (56) and gasket (57).

s. Hold throttle plates open and remove spring (58) and pin (59). Remove nut (60), lockwasher (61) and lever (62).

t. Remove lockwashers (63) and separate housing (64) from throttle body (51). Remove spring (65), retainer (66) and seal (67).

u. Cut lockwire (68) and seal (69). Remove screws (70), cover (71) and diaphragm (72).

v. Remove screw (73) and cover ~~(74)~~

w. Remove retainer ~~link (75)~~ from lever (76). Remove lever (76).

x. Remove screws (77), housing (78) and gasket (79).

y. Remove screws (80), cover (81), spring (82) and diaphragm (83). Retain check valve ball and retainer with housing (78).

z. Mark the primary and secondary throttle plates (84 and 85) and the bore in which each is installed so they can be reinstalled in the same bore at reassembly. Mark left and right choke plates (86 and 87) in a similar manner.

aa. Remove screws (88) and choke plates (86 and 87). Carefully pull choke shaft (89) out of throttle body. Remove two nozzle extensions (90). File off the spread-out tip of each screw (88) to prevent damage to threads on the choke shaft. Do not damage shaft, plates or bores with the file.

ab. Remove screws (91) and bracket (92). Remove screw (93), nut (94) and clamp (95).

ac. File off the spread-out tip of each screw (96) and remove these screws and the throttle plates (84 and 85). Do not damage throttle shaft, plates or bores with the file.

ad. Remove screw (97) and housing (98).

ae. Carefully extract shaft (100) from throttle body. Remove throttle (101) and gasket (102).

af. Remove stop screw (103) and spring (104) and carefully remove shaft (99) from throttle body.

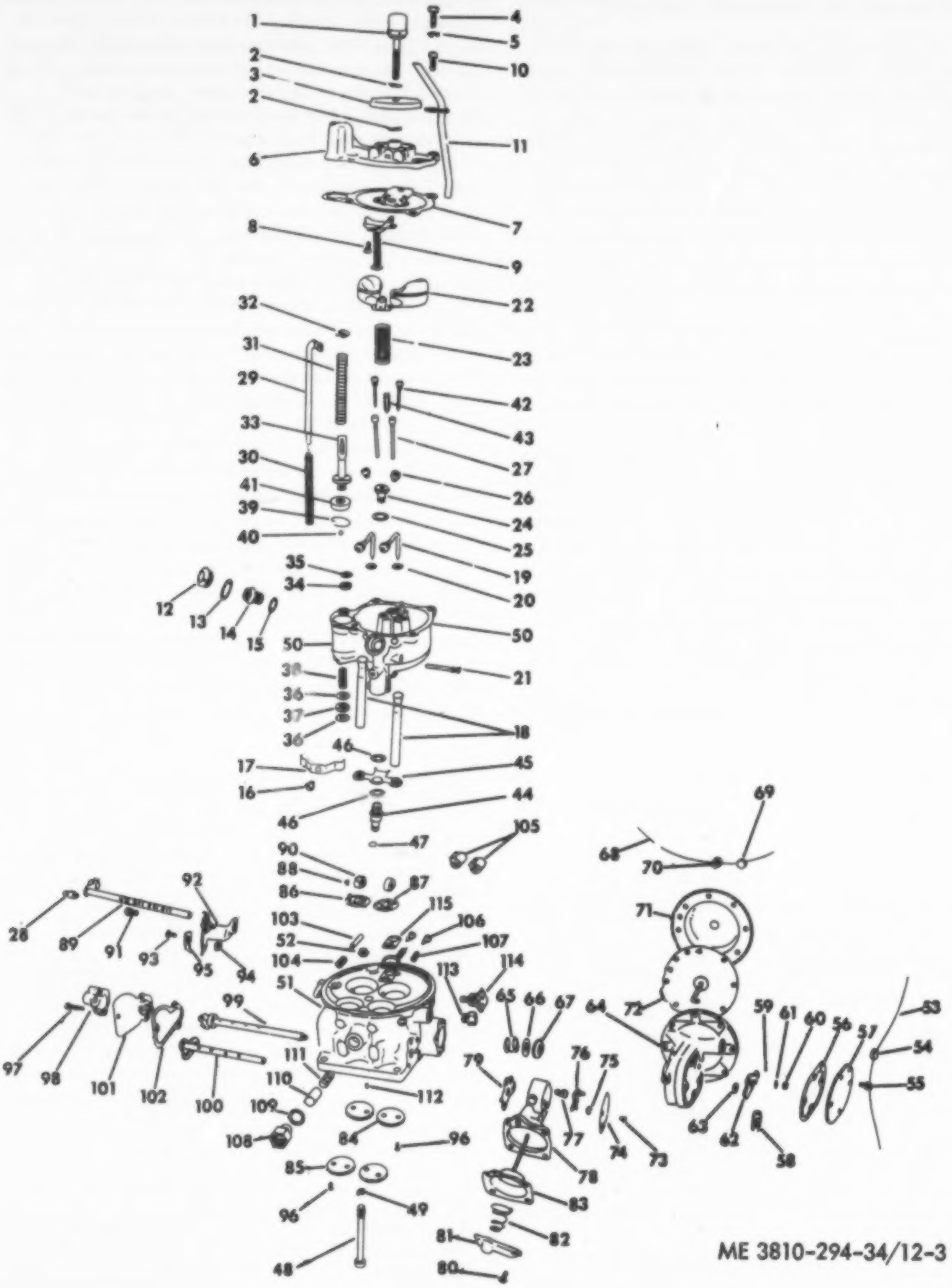
ag. File or ground off the side of limited caps (105). Remove adjusting needles (106) and springs (107).

ah. Remove fitting (108), gasket (109), screen (110) and spring (111).

ai. Remove plug (112), fitting (113), plug (114), gasket (115).

KEY to fig. 12-3.

1. Screw
2. Lockwasher
3. Cover
4. Screw
5. Lockwasher
6. Cover w / plugs
7. Cover gasket
8. Screw with lockwasher
9. Diaphragm w / stem
10. Screw with lockwasher
11. Tube w / clip
12. Plug
13. Gasket
14. Valve w / seat
15. Gasket
16. Screw with lockwasher
17. Clamp
18. Venturi
19. Tube assembly
20. Gasket
21. Shaft
22. Float w / hinge
23. Spring
24. Valve assembly
25. Gasket
26. Jet
27. Tube assembly
28. Stud
29. Rod
30. Spring
31. Spring
32. Washer
33. Piston
34. Seal
35. Washer
36. Washer
37. Seal
38. Spring
39. Valve retainer
40. Ball
41. Piston cup
42. Tube assembly
43. Valve
44. Fitting
45. Bracket
46. Gasket
47. Seal
48. Screw
49. Lockwasher
50. Body w / plugs
51. Body w / shaft and screw
52. Spacer
53. Seal wire
54. Lead seal
55. Screw w / lockwasher
56. Housing cover
57. Gasket
58. Spring
59. Pin
60. Lever nut
61. Lockwasher
62. Lever assembly
63. Lockwasher
64. Housing
65. Spring
66. Retainer
67. Shaft seal
68. Seal wire
69. Seal
70. Screw w / lockwasher
71. Cover
72. Diaphragm w / rod
73. Screw w / lockwasher
74. Cover
75. Retainer
76. Lever assembly
77. Screw w / lockwasher
78. Housing w / cover
79. Housing gasket
80. Screw w / lockwasher
81. Housing w / cover
82. Spring
83. Diaphragm
84. Plate
85. Plate
86. Plate assembly
87. Plate assembly
88. Screw w / lockwasher
89. Shaft w / lever
90. Extension assembly
91. Screw w / lockwasher
92. Bracket
93. Screw
94. Nut
95. Clamp
96. Screw
97. Screw w / lockwasher
98. Housing w / bushing
99. Shaft w / bearing
100. Shaft w / lever
101. Shaft assembly
102. Gasket
103. Screw
104. Spring
105. Cap
106. Needle
107. Spring
108. Fitting
109. Gasket
110. Screen assembly
111. Spring
112. Plug
113. Fitting
114. Plug
115. Gasket


1
4
5
2
10
3
2
11
6
7
8
9
22
32
23
31
29
42
43
33
27
30
26
41
24
39
25
40
19
35
20
34
12
13
14
15
50
50
21
38
36
37
18
36
46
45
17
16
44
46
69
105
47
68
70
90
88
87
86
92
71
115
103
106
28
89
91
93
52
107
104
95
94
113
114
51
72
65
66
67
64
59
61
60
56
57
53
99
54
97
98
101
102
100
111
79
76
75
63
62
55
110
112
77
74
73
58
109
108
84
96
78
85
83
96
49
82
81
48
80

ME 3810-294-34/12-3

Figure 12-3. Carburetor, exploded view.

12-12. Cleaning

Wash all parts except those with neoprene diaphragms in dry cleaning solvent (Federal Specification P-S-661). Place the parts to be cleaned in a metal basket suspended in the cleaning solution and agitate the parts. After soaking the parts, rinse them in hot water. Remove remaining foreign matter with a stiff brush. After rinsing dry the parts with compressed air. Direct the air through all passages and tubes.

Caution: Do not clean jets and passages with a drill, wire or similar object. Doing so may distort the jets and passages and remove protective finishes.

12-13. Inspection and Repair

a. Replace castings that are cracked, have scored mating surfaces or are otherwise damaged.

b. Replace any part with worn or damaged threads.

c. Blow compressed air through all tubes and jets to insure they are open. Re-clean any clogged passages.

d. Replace all bent or distorted adjusting screws and needles.

e. Replace the float if it leaks or is corroded. Shake the float to determine if fuel has leaked into it. Replace inlet needle and seat if either is damaged.

f. Replace accelerator pump check valve and discharge needle if they are nicked or grooved. Replace piston cup if worn or damaged. Polish pump rod with crocus cloth if the finish is rough or corroded. Lubricate rod with graphite grease before reassembly.

g. Check that choke shaft and choke plates turn freely inside and around nozzle extensions. Check nozzle extensions for rough edges and worn bearing surfaces. Replace extensions if there is binding.

h. Replace choke and throttle plates if edges are nicked or if protective plating has been damaged. Check that poppet valve operates freely in choke plates.

i. Check choke and throttle shafts for bending, wear on bearing surfaces, and loose riveted levers. Replace any shaft with these defects.

j. Check action of economizer diaphragm and replace if defective. Check that power valve operates freely without sticking.

k. Replace all choke and throttle levers that are bent or worn.

l. Replace all broken or distorted springs.

m. Replace governor spring port if bent or worn. Check that modulator lever operates freely.

n. Replace all gaskets and seals.

12-14. Reassembly and Installation

a. Install plug (114), fitting (113) and plug (112)

b. Install spring (111), screen (110), gasket (109) and fitting (108).

c. Install springs (107), adjusting needles (106) and cap (105). Turn in needles lightly to seat and then back them off 1¼ turns.

d. Insert shaft (99) in body and replace spring (104) and stop screw (103).

e. Install gasket (102), throttle (101) and shaft (100).

f. Install housing (98) and screw (97).

g. Replace throttle plates (84 and 85) in the bores from which they were removed. Install screws (96). When installing the secondary plates, place a .005 — .006 — inch shim about ⅛-inch wide between the lowered side (viewed from top) of each plate and the barrel. Hold the throttle plates closed while tightening the screws to insure proper closing of the plates.

h. Install clamp (95), screw (93) and nut (94). Mount bracket (92) and install screws (91).

i. Install choke shaft (89) and choke plates (86 and 87) in body. Be sure to replace choke plates in the bores from which they were removed. Install screws (88) and nozzle extensions (90).

j. Install diaphragm (83), spring (82), cover (81) and screws (80).

k. Set gasket (79) in place and install housing (78) and screws (77).

l. Replace lever (76). Attach retainer link (75) to lever (76).

m. Install cover (74) and screw (73).

n. Install diaphragm (72), cover (71) and screws (70). Turn in screws until both flange surfaces come together. Pull diaphragm rod as far toward throttle shaft as possible. Hold in this position and tighten alternate screws (70). Release rod and tighten all screws. Lock the screws with lock wire (68) and a seal (69).

o. Install seal (67), retainer (66) and spring (65). Mount housing (64) on throttle body and secure with lockwashers (63).

p. Install lever (62), lockwasher (61), nut (60) and pin (59). Hold throttle plates open and install spring (58).

q. Install gasket (57) on housing (64). Install cover (56) and secure with screws (55). Lock screws with lock wire (53) and seal (54).

r. Install gasket (115) and spacer (52). Join main body (50) to throttle body (51) and secure with screws (48) and lockwashers (49). Torque both screws to 4-5 foot-pounds.

s. Install seal (47), gaskets (46), bracket (45) and fitting (44). Tighten fitting securely.

t. Install needle valve (43), main well tubes (42) and piston cup (41).

u. Install valve ball (40) and retainer (39). Work ball into seat with a brass rod and light mallet. Set the retainer in bore so that projection of spring is located over ball. Be sure spring is bottomed in groove.

v. Install spring (38), seal (37), washers (36), flat washer (35) and rod seal (34).

w. Install piston (33), spring (31) and spring washer (32). Install spring (30) and rod (29). Connect accelerator pump linkage and install stud (28).

x. Install idler tubes (27) and main jets (26).

y. Install gasket (25) and power valve (24).

z. Insert long end of spring (23) in small hole in float lever. Holding spring with index finger, ease float (22) into bowl and slip spring over hose at bottom of bowl. Install shaft (21). Check float level as follows.

(1) Lift float to close fuel inlet valve completely. Hold float in this position.

(2) Place a straight edge across float chamber with one end on rim of float chamber and the other end on center of main body. Measure distance between lower edge of straight edge and the flat top surface of float farthest from inlet valve. This distance should be ¼ inch.

(3) Check both halves of float in this manner. If distances are not equal, bend that part of float lever next to float so distances are equal. Bend only a slight amount. Adjust the float level by bending tab on float lever which contacts the inlet needle. Bend tab up to lower float and down to raise float.

aa. Install gaskets (20) and jet tubes (19). Position ends of jets so they are above but not touching power valve.

ab. Install tubes (18), clamp (17) and screw (16).

ac. Install tube (11) and screw (10).

ad. Install diaphragm (9) and screws (8). Compress the spring while tightening the screws.

ae. Install gasket (7), cover (6) and secure with lockwashers (5) and screws (4).

af. Insert screw (1) through cover (3) with a lockwasher (2) on each side of cover and thread screw into cover (3).

ag. Refer to TM 5-3810-294-20 to install carburetor on engine and make carburetor adjustments.

Section V. REPAIR OF WATER PUMP

12-15. Description

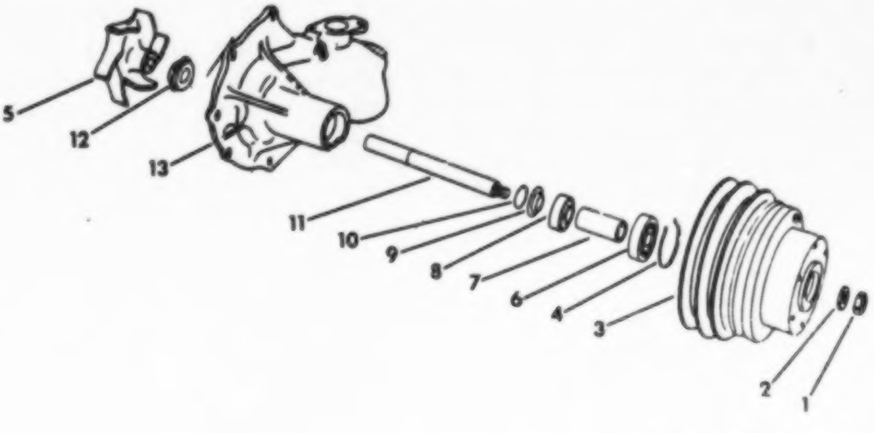
The water pump is built into the engine front gear cover and supplies both cylinder banks. The coolant flows from the radiator directly to the cylinder heads. There it is equally metered to each cylinder and most of the coolant is forced directly past the exhaust valve wet guides and the valve seat area. An idler pulley provides the means of adjusting the two water pump and fan pulley belts.

12-16. Removal

Refer to TM5-53810-294-20 for instructions to remove the water pump from the engine.

12-17. Disassembly

Refer to figure 12-4 and disassemble water pump as follows:



1. Nut
2. Washer
3. Pulley
4. Retaining ring
5. Impeller
6. Bearing
7. Spacer
8. Bearing
9. Slinger
10. Lock ring
11. Shaft
12. Seal
13. Body

Figure 12-4. Water pump, exploded view.

a. Remove nut (1), washer (2) and press pulley (3) off shaft.

b. Remove retaining ring (4).

c. Set the pump on an arbor press and press the shaft and bearings as a unit out of the impeller (5).

d. Press off the bearing (6), spacer (7), bearing (8), slinger (9), and lock rings (10). Be careful not to lose the half rings.

e. Use a drift pin and drive the seal (12) out of body (13).

12-18. Cleaning

Wash all metal parts with dry cleaning solvent (Federal Specification P-S-661) and dry with compressed air.

12-19. Inspection and Repair

a. Replace seal if it is worn, corroded or damaged.

b. Replace bearings if worn or corroded.

c. Replace shaft if worn at the ends.

d. Replace all parts with worn or damaged threads.

12-20. Reassembly and Installation

Refer to figure 12-4 and reassemble the pump as follows:

a. Press a new seal (12) into body (13).

b. Pack bearings with grease and install bearing (8), spacer (7) and bearing (6) on shaft (11). Place slinger (9) in position.

c. Place two lock rings (10) in groove of shaft and press shaft toward pulley end into bearings until bearing (8) rests firmly against slinger (9) and lock rings (10).

d. Fill cavity with 1½ ounces of short fiber bearing grease. Install shaft and bearing assembly into body and secure with retaining ring (4).

e. Press pulley (3) onto shaft and secure with washer (2) and nut (1).

f. Press impeller (5) onto shaft until axial distance from mounting surface of pump body to end of impeller is 1 1/16 inches.

g. Install water pump on engine as instructed in TM 5-3810-294-20.

Section VI. REPAIR OF AIR COMPRESSOR

12-21. Description

The air compressor is lubricated by oil from the engine system and cooled by water from the engine system. Therefore, lubrication and cooling depend upon proper lubrication and cooling for the engine. Intake air is taken from the clean air side of the engine air cleaner.

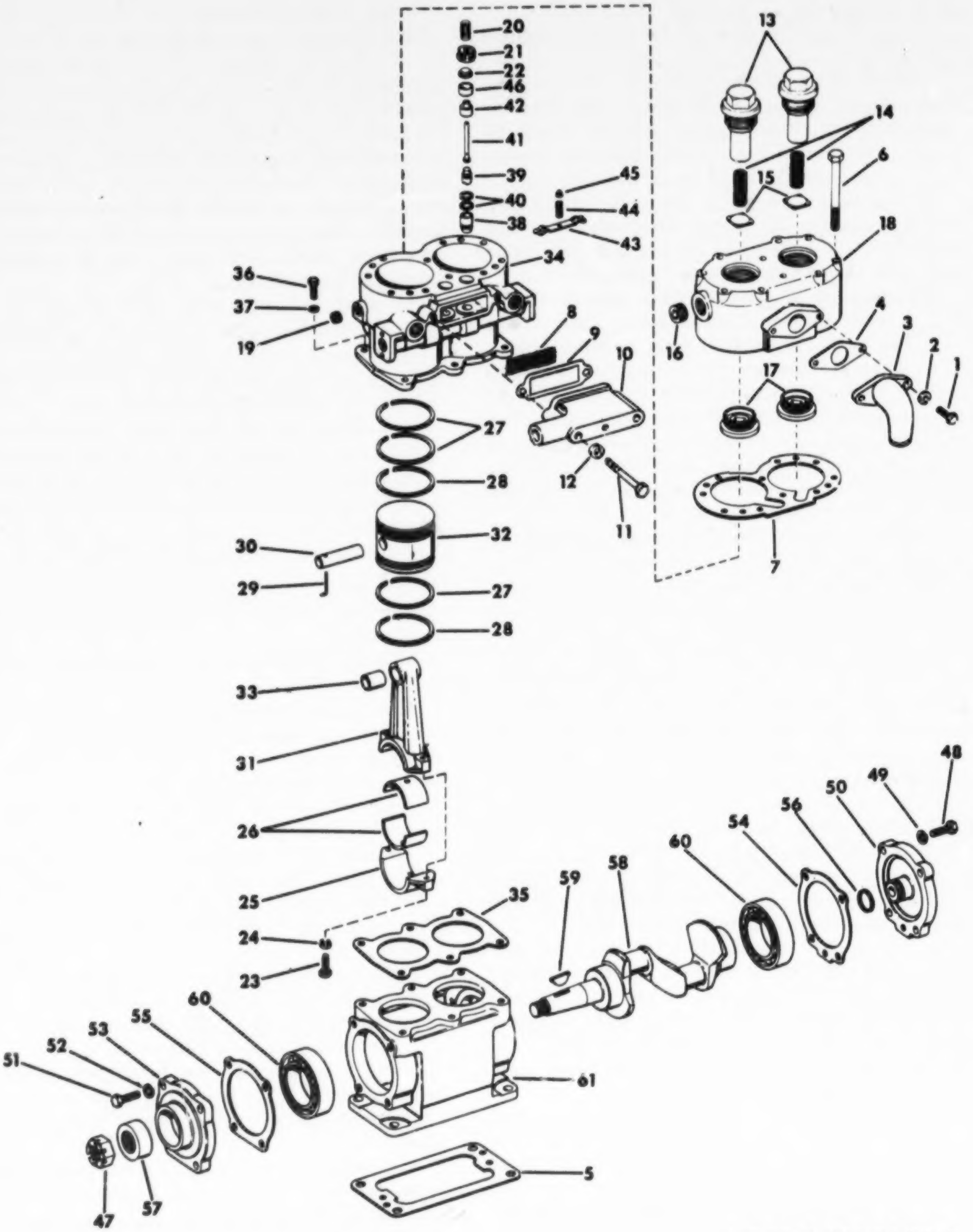
12-22. Removal

Refer to TM 5-3810-294-20 for instructions to remove the air compressor from the engine.

12-23. Disassembly

Refer to figure 12-5 and disassemble the compressor as follows.

KEY to fig. 12-5.
1. Hex head screw (2)
2. Lockwasher (2)
3. Discharge fitting
4. Gasket
5. Gasket
6. Screw (10)
7. Gasket
8. Screen
9. Gasket
10. Air intake connector
11. Screw (2)
12. Lockwasher (2)
13. Cap (2)
14. Spring (2)
15. Valve (2)
16. Plug
17. Seat (2)
18. Cylinder head
19. Plug (6)
20. Spring (2)
21. Valve (3)
11. Guide (2)
23. Screw (4)
24. Lockwasher (4)
25. Cap
26. Bearing insert (4)
27. Ring (4)
28. Ring (4)
29. Lock wire (2)
30. Pin (2)
31. Connecting rod (2)
32. Piston (2)
33. Bushing (2)
34. Cylinder block
35. Gasket
36. Screw (6)
37. Lockwasher (6)
38. Stop (2)
39. Cup (2)
40. Packing (4)
41. Piston (2)
42. Seat (2)
43. Saddle
44. Spring
45. Seat
46. Bearing (2)
47. Nut
48. Screw (4)
49. Lockwasher (4)
50. Cover
51. Screw (4)
52. Lockwasher (4)
53. Cover
54. Gasket
55. Gasket
56. Packing
57. Seal
58. Crankshaft
59. Key
60. Bearing (2)
61. Compressor body


20
21
22
46
42
41
39
40
38
45
44
43
13
14
6
15
18
36
34
37
19
8
9
10
16
4
3
2
1
17
27
28
12
11
7
32
30
29
27
28
33
31
48
49
50
56
54
60
58
59
26
25
35
24
23
55
53
52
51
60
61
47
57
5

ME 3810-294-34/12-5

Figure 12-5. Air compressor assembly exploded view.

a. Remove two screws (1) and lockwashers (2) and remove discharge fitting (3) and gasket (4) from compressor.

b. Remove flange gasket (5) from the base of the compressor.

c. Mark the cylinder head (18) and cylinder block (34) to assure correct reassembly. Remove two screws (6) and loosen cylinder head by breaking the gasket joint. Lift cylinder head away from cylinder block. Remove gasket (7).

d. Remove inlet connector (items 8 through 12).

e. Remove two discharge valve seats (17) and caps (13) from cylinder head (18). Lift out spring (14) and valves (15). Remove plug (16).

f. Remove six plugs (19) from cylinder block.

g. Remove both inlet valve spring (20), valves (21) and valve guides (22) from cylinder block.

h. Working through the bottom of the compressor body (57) remove four screws (23) and lockwashers (24) from the connecting rods. Tap connecting rod caps (25) with a brass hammer to loosen and remove caps and inserts (26). Push the connecting rod and piston assemblies out through the top of the cylinder block (34).

i. Using a piston ring expander, remove compression rings (27) and oil scrapers rings (28) from pistons. Remove lock wires (29), press piston pins (30) from pistons, and separate connecting rods (31) from pistons (32). Press out bushings (33).

j. Mark the cylinder block (34) and compressor body (61) to assure correct reassembly. Remove six screws (36) and lockwashers (37). Tap cylinder block with a brass hammer to break the gasket joint and remove the cylinder block from the compressor body. Remove gasket (35).

k. Remove unloader cup stop (38), unloader cup (39), packings (40), unloader piston (41), and inlet valve seat (42) from cylinder block.

l. Remove unloader spring saddle (43), spring (44) and unloader spring seat (45) from cylinder block. Press sleeve bearing (46) from body.

m. Mark the end covers (50 and 53) and compressor body (61) to assure correct reassembly. Remove nut (47), eight screws (48 and 51) and lockwashers (49 and 52). Remove front and rear covers (50 and 53) and gaskets (54 and 55). Remove packing (56) from rear cover and press seal (57) out of bore in front cover.

n. Mark the crankshaft (58) and compressor body to assure correct reassembly. Press the crankshift and bearing assembly out of the compressor body (61). Remove key (59).

o. Use a suitable bearing pulley and pull out bearings (60) from crankshaft (58).

12-24. Cleaning

Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and blow dry with compressed air. Scrape all remaining gasket material from machined surfaces. Do not damage surface while scraping.

12-25. Inspection and Repair

a. Remove nicks and burrs from machined surfaces of cylinder head body with a fine file or handstone. Replace parts with damaged threads. Replace body if cracked or damaged beyond repair.

b. Replace worn inlet and outlet valves and valve seats.

c. Remove score marks from bearing bores and machined surfaces of compressor body with a fine file or handstone. Replace body if cracked or damaged beyond repair.

d. Replace piston if cracked or worn in ring grooves. Replace worn or damaged piston rings.

e. Remove scratches and score marks from bearing surfaces of crankshaft with a fine file or handstone. Replace crankshift if worn.

f. Replace cracked or damaged compressor body. Replace body if bores are worn or out of round.

g. Replace worn or damaged compressor pulley.

h. Replace damaged tube assembly or mounting bracket.

i. Replace all gaskets and packings.

12-26. Reassembly and Installation

Refer to figure and reassemble the air compressor as follows:

a. Using a suitable press, press bearings (60) on crankshaft (58).

b. Aline crankshaft and compressor body (61) according to removal markings. Carefully press crankshaft and bearing assembly into compressor body with a suitable arbor press.

c. Install packing (56) in rear cover (50) and press seal (57) in front cover (53).

d. Install rear cover gasket (54), with oil hole in gasket alined with oil hole in body. Install rear cover (50) on body according to removal marks and secure cover with four screws (48) and lockwashers (49).

e. Install gasket (55) and front cover (53) on body according to removal markings and secure cover with four screws (51) and lockwashers (52).

f. Install key (59) in crankshaft keyway.

g. Press two unloader sleeve bearings (46) into cylinder block (34). Install unloader spring seat (45), spring (44) and spring saddle (43) in cylinder block.

h. Install four packings (40) on two unloader cups (39) and unloader cup stops (38).

i. Install two unloader cup stops, unloader cups, unloader pistons (41) and inlet valve seats (42) in cylinder block.

j. Install gasket (35) on compressor body (61).

k. Install cylinder block (34) on compressor body according to removal markings and secure with six screws (36) and lockwashers (37).

l. Press bushings (33) into connecting rods (31). Connect pistons (32) and connecting rods by pressing piston pins (30) into pistons and rods. Secure pins with lock wires (29).

m. Using a piston ring expander tool install four compression rings (27) and two oil scraper rings (28) in grooves on pistons (32).

n. Using a piston sleeve installer to compress piston rings, slide connecting rod and piston assemblies through top of cylinder block and into body. Install four bearing inserts (26), alining insert oil hole with rod oil hole. Install connecting rod caps (25) over bearing inserts around crankshaft journals. Secure caps to rods and four screws (23) and lockwashers (24).

o. Install two guides (22), inlet valves (21) and valve springs (20) in cylinder block body (34).

p. Install six pipe plugs (19) in cylinder block.

q. Install two discharge valve seats (17) and plug (16) in cylinder head (18). Install valves (15), springs (14) and secure with two discharge valve caps (13).

r. Install gasket (7) and cylinder head (18) on cylinder block according to removal markings and secure with ten screws (6).

s. Install discharge fitting (3) and gasket (4) on compressor and secure with two screws (1) and lockwashers (2). Install inlet connector assembly, items (8 thru 12).

t. Set gasket (5) in place and install compressor on engine as outlined in TM 5-3810-294-20.

Section VII. REPAIR OF HYDRAULIC PUMP

12-27. Description

The power steering system consists of a vane type hydraulic steering pump, the steering gear proper which contains a hydraulic control valve and a power cylinder, and mechanical steering control linkages. The operator is able to steer the machine even if hydraulic power is lost, although additional effort will be required.

12-28. Removal

Refer to TM 5-3810-294-20 for instructions to remove the pump from the engine.

12-29. Disassembly

Refer to figure 12-6 and disassemble the pump as follows:

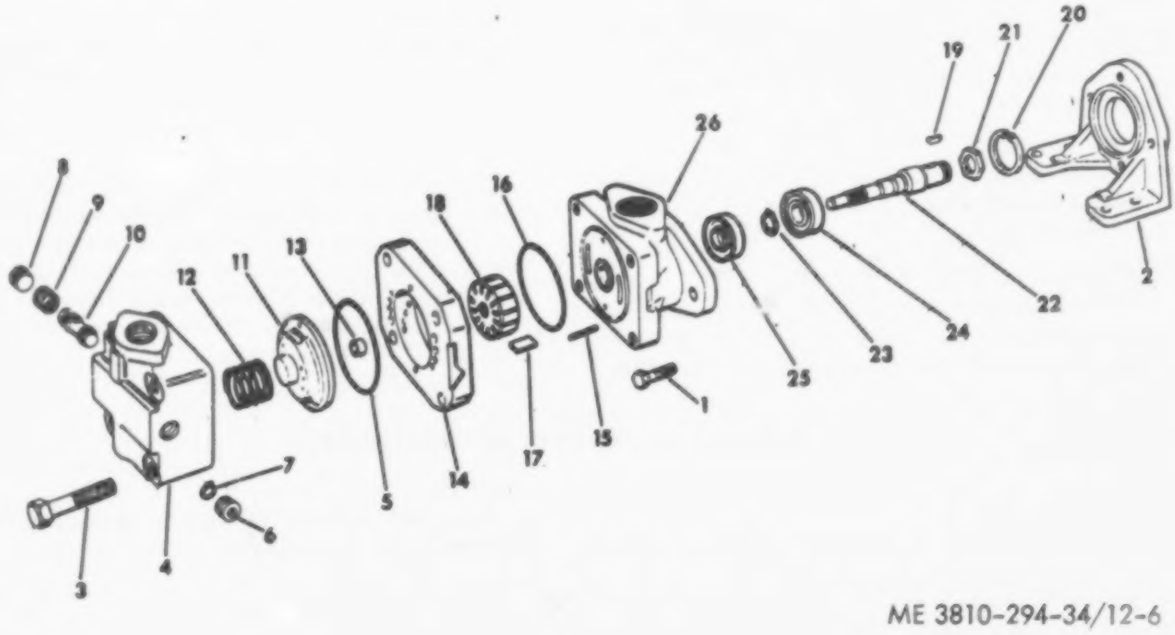


Figure 12-6. Hydraulic pump, exploded view.

KEY to fig. 12-6
1. Bolt
2. Mounting bracket
3. Screw
4. Cover
5. O -ring
6. Plug
7. Snap ring
8. Plug
9. Spring
10. Control valve
11. Pressure plate
12. Spring
13. Bushing
14. Ring
15. Pin
16. O-ring
17. Vane
18. Rotor
19. Key
20. Snap ring
21. Nut
22. Shaft
23. Snap ring
24. Bearing
25. Seal
26. Body

a. Remove bolt (1) and mounting bracket (2).

b. Clamp the pump firmly but not tightly in vise with cover end up. Note and mark the position of the cover (4) relative to the body (26). Remove screw (3) and cover (4). Lift off O -ring (5).

c. Remove plug (6) and snap ring (7) only if necessary.

d. Remove plug (8), spring (9) and control valve (10).

e. Remove pressure plate (11), spring (12) and bushing (13).

f. Note and mark position of ring (14) relative to body (26). Lift off ring (14) and remove pin (15). Lift off O -ring (16).

g. Take vanes (17) out of rotor (18) and take rotor off shaft.

h. Rotate pump body and remove key (19), snap ring (20), and nut (21). Tap with a soft hammer on the splined end of shaft (22) to drive shaft out of body.

i. Remove snap ring (23). Support inner race of bearing (24) and press shaft out of bearing.

j. Use a small wire hook and remove seal (25) from body (26).

12-30. Cleaning

Wash all metal parts with dry cleaning solvent (Federal Specification P-S-661) and dry them with compressed air.

12-31. Inspection and Repair

a. Discard the seal and both O -rings.

b. Check wearing surfaces of body, pressure plate, ring and rotor for scoring and excessive wear. Remove light score marks by lapping. Replace parts badly scored or worn.

c. Check vanes for burrs, wear and excessive play in slots. Replace rotor if slots are worn.

d. Check bearing for wear and replace if necessary.

e. Check oil seal mating surface on shaft for scoring and wear. Replace shaft if score marks cannot be removed with light polishing.

f. Check that control valve moves freely in cover. Remove burrs from valve by polishing but do not round off corners of lands. Do not rework valve bore. If bore is damaged, replace cover.

12-32. Reassembly and Installation

Refer to figure 12-6 and reassemble the pump as follows:

a. Coat all parts with hydraulic fluid to facilitate assembly and provide initial lubrication. Use petroleum jelly to hold O -rings in place during assembly.

b. Install snap ring (7) and plug (6) if they were removed. Be sure snap ring is seated in groove in cover.

c. Insert valve (10), small land first, in cover. Install spring (9) and plug (8).

d. Press bearing (24) onto shaft (22) and then press shaft and bearing into body (26). Install snap rings (20 and 23).

e. Install seal (25) with spring toward cover end of pump. Press seal in place and lubricate lip with petroleum jelly or other lubricant compatible with the system fluid.

f. Install key (19) and nut (21).

g. Install O -rings (16 and 5). Insert pins (15) on body and install ring (14). Check position as marked in step f. of disassembly.

h. Install rotor (18) on shaft and insert vanes (17) in rotor.

i. Install bushing (13) in pressure plate (11). Install plate on locating pins and flat against ring.

j. Place spring (12) in recess of pressure plate and carefully install cover (4). Check cover position as marked in step b. of disassembly. Install screws (3) and torque them to 80±5 foot-pounds.

Section VIII. REPAIR OF RADIATOR

12-33. General

The carrier radiator is repaired in the same manner as the crane radiator. Refer to chapter 3 for radiator repair instructions.

CHAPTER 13

REPAIR OF CARRIER ENGINE

Section I. GENERAL

13-1. Description

The carrier engine is a V-8, International Harvester engine model UV-549. The V-8 engine is of the overhead valve type, with two banks of cylinders at a 90 degree angle. The cylinder block and upper crankcase are cast in one piece with cored passages for cooling the entire length of the engine.

13-2. Engine Removal

Refer to paragraph 11-8 for engine removal instructions. Place engine on suitable engine stand to facilitate disassembly.

13-3. Preparation for Repair

a. Refer to TM 5-3810-294-20 and remove the following.

(1) Radiator and fan

(2) Electrical components including generator, plugs, distributor, starting motor, sending units, and wiring

(3) Fuel pump, fuel filter, and fuel and vent lines

(4) Carburetor

(5) Air compressor

(6) Hydraulic pump

(7) Air cleaner connections

(8) Oil filter

(9) Oil cooler

(10) Water pump

(11) Manifolds

b. With the above accessories removed from the engine, the following disassembly and procedures can be accomplished.

Section II. REPAIR OF CYLINDER HEAD, ROCKER ARM AND VALVES

13-4. Description

The cylinder heads can be interchanged from one cylinder bank to another by changing the water jacket hole cover plates and the engine heat indicator sending unit. The head gaskets are also interchangeable. Both heads are equipped with a positive valve rotating mechanism on the intake exhaust valve.

13-5. Removal

Refer to figure 13-1 and remove heads as follows:

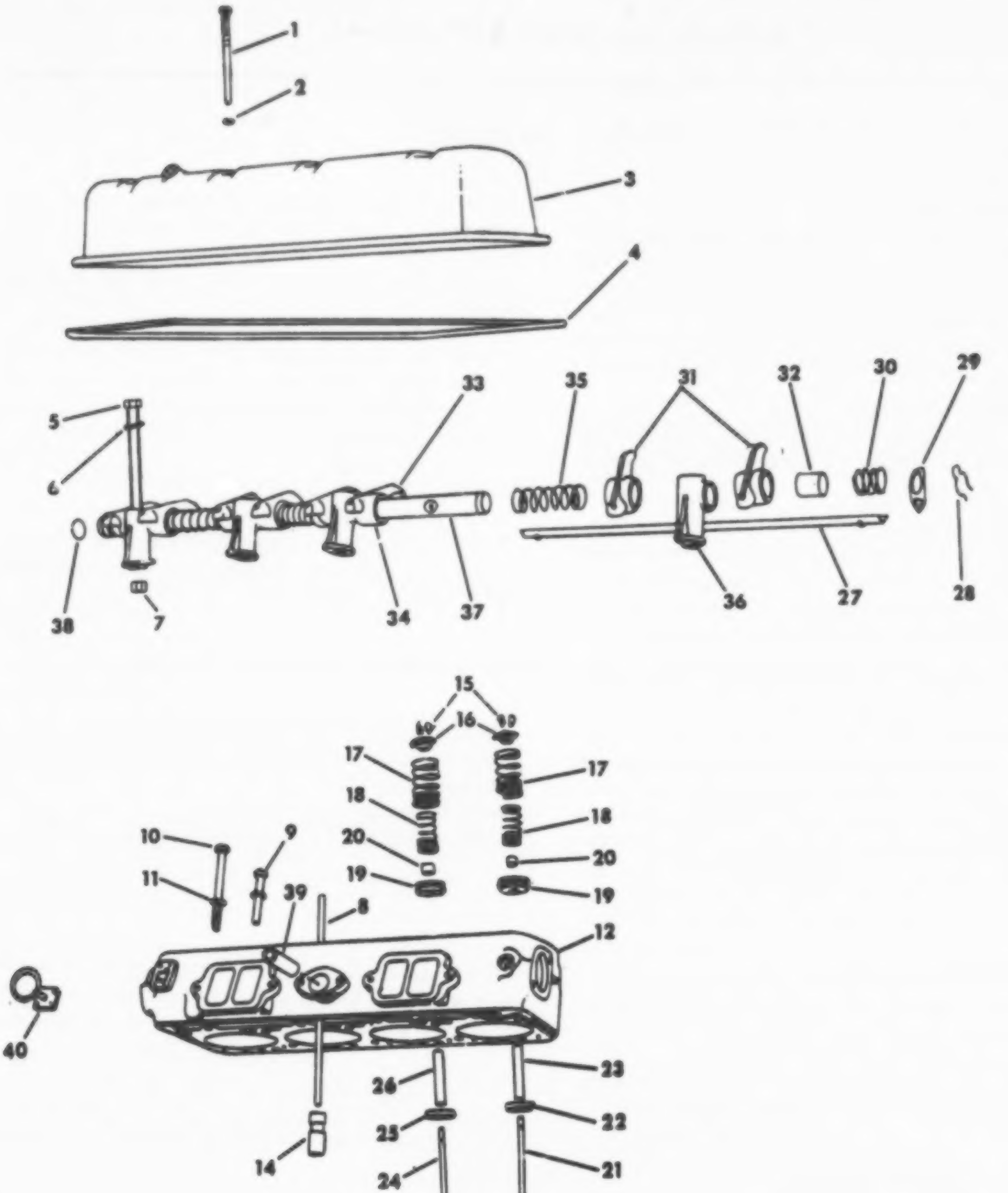

1
2
3
4
5
6
33
35
31
32
30
29
38
7
34
37
36
27
28
15
16
17
17
18
18
20
20
19
19
10
9
11
39
8
12
40
23
26
22
25
21
14
24
13
ME 3810-294-34/13-1

Figure 13-1. Cylinder head, rocker arm, and valve, exploded view.

Key to fig. 13-1.
1. Capscrew (8)
2. Lockwasher (8)
3. Cover (2)
4. Gasket (2)
5. Bolt (8)
6. Washer (8)
7. Sleeve bearing (2)
8. Pushrod (16)
9. Head bolt (12)
10. Head bolt (16)
11. Washer (28)
12. Cylinder head (2)
13. Gasket (2)
14. Tappet (16)
15. Spring lock (32)
16. Spring retainer (16)
17. Outer spring (16)
18. Inner spring (16)
19. Valve rotor (16)
20. Oil seal (16)
21. Exhaust valve (8)
22. Exhaust seat (8)
23. Valve guide (8)
24. Intake Valve (8)
25. Intake seat (8)
26. Valve guide (8)
27. Oil trough (2)
28. Retaining ring (4)
29. Washer (4)
30. Spring (4)
31. Rocker arm (4)
32. Sleeve bearing (8)
33. Rocker arm bracket (4)
34. Sleeve bearing (8)
35. Spring (4)
36. Bracket (4)
37. Rocker arm shaft (4)
38. Expansion plug (2)
39. Exhaust tube
40. Lifting attachment (2)

a. Remove capscrew (1), lockwasher (2), cover (3) and gasket (4).

b. Remove rocker arm bracket bolt (5) and washer (6), and lift rocker arm assembly from head.

c. Remove sleeve bearings (7) and pushrods (8).

Note. Mark pushrods for installation in identical position at reassembly.

d. Remove head bolts (9 and 10), and washers (11).

e. Remove cylinder heads (12) and gaskets (13). Remove tappets (14).

13-6. Disassembly

Refer to figure 13-1 and disassemble as follows.

a. Compress valve springs and remove locks (15). Release springs and remove retainers (16), outer springs (17), and inner springs (18). Remove valve rotor (19) and oil seal (20).

b. Remove exhaust valves (21), exhaust seats (22), and exhaust valve guides (23). Remove intake valves (24), intake seats (25), and intake valve guides (26).

c. Remove oil trough (27), retaining rings (28), rings (29), and springs (30).

d. Remove rocker arms (31), rocker arm brackets (33), bearing (32 and 34), rings (35), and brackets (36) from shafts (37). Remove plugs (38) and exhaust tube (39).

13-7. Cleaning

a. Clean head and crankcase deck thoroughly. All carbon must be removed from the intake manifold section, bottom face of the head, and from the valve ports and guide bores.

b. Flush out water passages to remove any accumulation of salt, slime, or sludge.

c. Clean all metal parts with dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly.

d. Remove all remaining gasket material from parts.

e. Clean all bearings carefully with solvent and allow to dry. Do not use compressed air to dry bearings. Coat all bearings and metal parts with oil immediately after drying.

f. Clean all oil holes and passages with brass probes.

13-8. Inspection

a. Inspect heads for water leaks or cracks in the combustion chamber, exhaust ports or around the valve seats. Inspect all machined surfaces for mars, pits, etc.

b. Check heads for warpage. If more than a 0.003 inch feeler gage can be inserted under the straight edge, planing is necessary. The heads may be planed to a maximum of 0.010 inches. Both heads must be planed if either requires planing.

c. Examine each valve for evidence of burning or warping. Inspect valve springs for proper tension (refer to table 1-4). Any evidence of wear, cracks, or permanent set requires replacement.

d. Inspect valve locks for wear and rotate the rotor caps to assure that they are clean and free to rotate.

e. Check valve guide bore dimensions against values in table 1-4. Inspect for evidence of water leakage around the exhaust valve guides.

f. Inspect the valve seat inserts for looseness, burned or cracked condition.

g. Inspect rocker arm shaft. Check on a surface plate for signs of bending and /or wear from rocker arms. If the shaft is bent or shows excessive wear, it must be replaced.

h. Inspect valve stem contact pad surface of rocker arm, and resurface if wear is excessive. Do not remove more than 0.010 inch of material when resurfacing rocker arm pad.

i. Inspect rocker arm tension springs for breakage or loss of tension.

j. Inspect rocker arm bushings for proper clearance to shaft. See table 1-4 for wear limits.

k. Retap damaged threads in tap holes of head.

l. Replace covers if cracked, bent or distorted.

13-9. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Measure cylinder head height before resurfacing. Refer to table 1-4 for minimum height.

c. Clean all carbon from valve and stems, using a fine wire brush or buffing wheel.

d. Refacing of valves and valve seats must be done with precision equipment to assure a good fit between parts. Refer to table 1-4 for valve face and seat angles.

e. If valve stem ends are grooved or scored, they must be ground to true up. Replace all damaged, worn, or unserviceable parts.

f. Check all parts against tolerances shown in Repair and Replacement Standards, table 1-4.

g. Replace valve guides if they are out of round or damaged. Replace cracked or worn rocker arms shafts. Replace weak, broken or distorted valve springs.

13-10. Reassembly and Installation

Refer to figure 13-1 and reassemble and install valves, head, and rocker arms as follows.

a. Install exhaust tube (39) and valve guides (23 and 26). Install valve seats (22 and 25).

b. Coat valves (21 and 24) with oil and install valves in same seat to which they were checked. Assemble valve rotors (19), oil seals (20), inner springs (18), outer springs (17), and spring retainer (16). Compress valve springs and install locks (15).

c. Install tappets (14) in block.

d. In placing new head gaskets on each bank over the alining dowel sleeves, be sure all bolt holes in the gaskets are in line with the holes in the block. Lift cylinder head (12) in place.

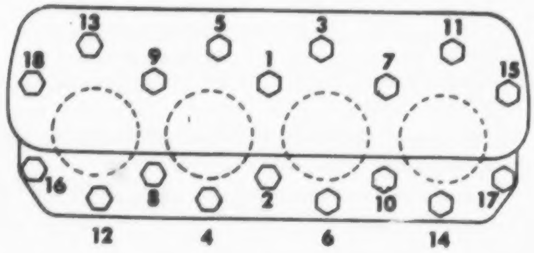
e. Loosely install head bolts (9 and 10), and washers (11) and insert pushrod (8) in place.

f. Install plugs (38) on rocker arm shaft (37). Install sleeve bearing (34) in rocker arm bracket (33) and bearing (32) in rocker arm (31). Reassemble bracket (36), bearing (35), rocker arm bracket (33), rocker arm (31) onto rocker arm shafts. Install spring (30) washer (29), retaining ring (28) onto rocker arm shafts. Install oil trough (27).

g. Install sleeve bearings (7) into head and set rocker arm in place. Loosely install bolts (5) and washers (6).

h. Tighten head bolts alternately and evenly in sequence as shown in figure 13-2 to a torque of 85 foot-pounds. Tighten rocker arm mounting bolts to torques of 85 foot-pounds.

i. Install gaskets (4, fig. 13-1), covers (3) and secure with capscrews (1) and washers (2).



ME 3810-294-34/13-2

Figure 13-2. Carrier engine head bolt tightening sequence.

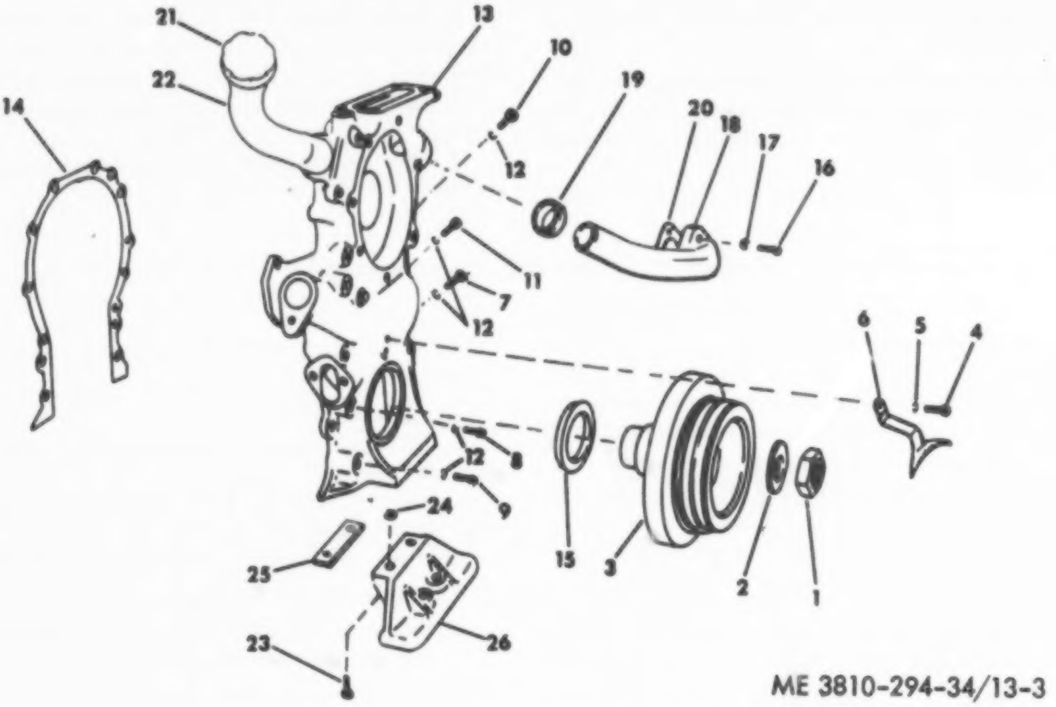
Section III. REPAIR OF GEAR COVER

13-11. Description

The gear cover encloses the three gears in the timing train.

13-12. Removal

Refer to figure 13-3 and remove gear cover as follows:



1. Nut	14. Gasket
2. Flat washer	15. Oil seal
3. Crankshaft pulley	16. Capscrew (2)
4. Screw (2)	17. Lockwasher (2)
5. Lockwasher (2)	18. Water inlet
6. Timing indicator	19. Packing
7. Capscrew (6)	20. Gasket
8. Capscrew (2)	21. Oil filter cap
9. Capscrew (4)	22. Oil filter pipe
10. Capscrew	23. Capscrew (2)
11. Capscrew	24. Nut (2)
12. Lockwasher (12)	25. Mount
13. Gear cover	26. Engine support

Figure 13-3. Gear cover, exploded view.

a. Remove nut (1), washer (2), and pull crankshaft pulley (3). Remove capscrews (4), lockwashers (5) and timing indicator (6).

b. Remove capscrews (7, 8, 9, 10 and 11), and lockwashers (12), and lift gear cover (13) from the crankcase. Remove gasket (14) and oil seal (15).

13-13. Disassembly

Refer to figure 13-3 and disassemble as follows:

a. Remove capscrews (16) and lockwashers (17), water inlet (18) and filler cap (19). Remove gasket (20).

b. Remove oil filler cap (21) and oil filler pipe (22).

c. Remove capscrews (23) and nuts (24). Lift off mount (25) and engine support (26).

13-14. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air.

b. Clean all remaining gasket material from parts.

13-15. Inspection

Examine all parts for cracks or breakage.

13-16. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace all defective parts.

13-17. Reassembly and Installation

Refer to figure 13-3 and reassemble and install gear cover as follows.

a. Replace mount (25) on engine support (26) and secure with bolts (23) and nuts (24).

b. Install oil filler pipe (22) and oil filler cap (21) on gear cover (13).

c. Install water inlet (18), gasket (20) and packing (19) on gear cover and secure with capscrews (16) and lockwashers (17).

d. Install gasket (14) and cover (13) onto crankcase and secure with capscrew (7, 8, 9, 10, 11) and lockwashers (12). Install new oil seal (15).

e. Install timing indicator (6) and secure with capscrews (4) and lockwashers (5).

f. Install crankshaft pulley (3) and secure with washer (2) and nut (1).

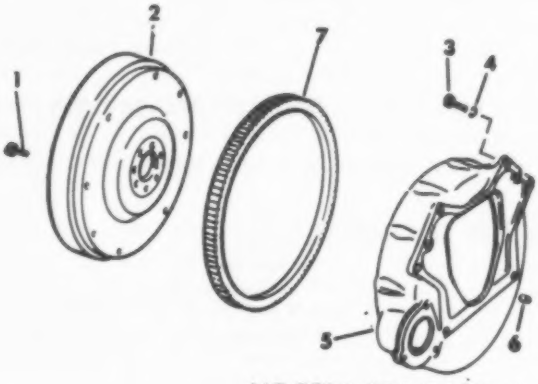
Section IV. REPAIR OF FLYWHEEL

13-18. Description

The flywheel is attached to the rear of the crankshaft. The flywheel, by its inertia, compensates for any fluctuations in engine speed.

13-19. Removal

Refer to figure 13-4 and remove flywheel as follows:



1. Capscrew (9)
2. Flywheel
3. Capscrew (6)
4. Lockwasher (6)
5. Flywheel housing
6. Pin (2)
7. Ring gear

Figure 13-4. Flywheel, exploded view.

a. Remove flywheel mounting capscrews (1), and lift flywheel (2) from the crankshaft flange. Remove capscrews (3), washers (4) and lift flywheel housing (5) off the engine. Remove pins (6).

b. If necessary, ring gear (6) may be removed by heating it with a torch and tapping it with a hammer.

13-20. Disassembly

No further disassembly is required.

13-21. Cleaning

Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly in compressed air.

13-22. Inspection

a. Check flywheel dowels, mounting holes, and ring gear teeth.

b. Inspect the flywheel housing-to-crankcase pilot dowel holes for wear.

c. Check the flywheel pilot bearing for wear.

13-23. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace all defective parts.

13-24. Reassembly and Installation

Refer to figure 13-4 and assemble and install flywheel as follows.

a. Heat ring gear (7) in a hot oil bath and place it onto flywheel (2) while the ring gear is hot. The chamfered edge of the ring gear is placed on the flywheel first.

Note. Before mounting the flywheel housing, the mating surface of the crankcase and housing must be free from burrs, ridges, etc. Such defects will result in excessive face run out.

b. Place housing (5) over the two flywheel housing-to-crankcase pins (6) and tap into place with a soft hammer.

c. Install capscrews (3) and lockwashers (4), and torque to 70 foot-pounds. Check housing face run out and compare with values shown in table 1-4. If run out exceeds limits, remove the housing and proceed to step d. below.

d. Remove pins (6) from crankcase. Install housing but do not tighten bolts to full torque. Position the housing within limits given in table 1-4. Tighten all bolts to full torque. Recheck run out and ream the dowel holes for oversize dowels.

e. After housing is installed, lubricate the flywheel pilot bearing and install the flywheel and ring gear assembly in position on the dowel end of crankshaft flange.

f. Install capscrews (1), and torque to 95 foot-pounds.

Section V. REPAIR OF OIL PAN AND OIL PUMP

13-25. Description

The oil pump is internally mounted at the bottom of the crankcase and is gear driven by the camshaft. Oil is drawn from the pan through a screen at the pump.

13-26. Removal

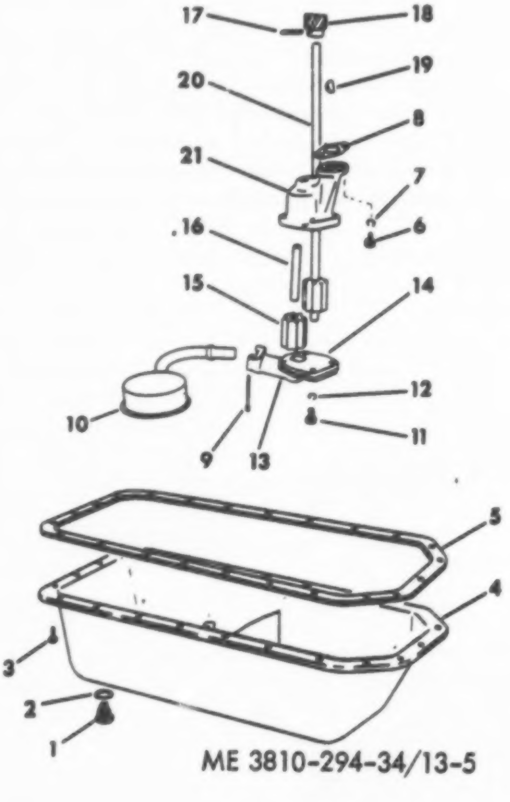
Refer to figure 13-5 and remove the oil pan and oil pump as follows:

a. Remove drain plug (1) and gasket (2).

b. Remove capscrews (3) and oil pan (4). Remove gasket (5).

c. Remove capscrew (6) and lockwasher (7) and lower oil pump from engine.

Note. To remove the oil pump, it is necessary to position the crankshaft rear couterweight away from the oil pump shaft.



1. Drain plug
2. Gasket
3. Capscrew (23)
4. Oil pan
5. Gasket
6. Capscrew (2)
7. Lockwasher (2)
8. Gasket
9. Cotter pin
10. Inlet screen
11. Capscrew (4)
12. Lockwasher (4)
13. Pump cover
14. Gasket
15. Idler gear
16. Shaft
17. Pin
18. Drive gear
19. Key
20. Shaft
21. Pump body

Figure 13-5. Oil pan and oil pump, exploded view.

13-27. Disassembly

Refer to figure 13-5 and disassemble oil pump as follows.

a. Remove gasket (8), cotter pin (9), and inlet screen (10).

b. Remove capscrews (11), lockwashers (12), pump cover (13) and gasket (14).

c. With the pump cover removed and the gears and shaft in place, press against the gears with the thumb to push the gears away from the outlet side of the pump. Measure the clearance between outside diameter of gear and bore of the housing. Compare with values shown in table 1-4. If less than this value, replace body or shaft. Check the pump shaft clearance in the bore. Compare with values given in table 1-4. Check backlash between pump body gears. If this exceeds the amount specified in table 1-4, replace gears.

d. Lift out idler gear (15) and shaft (16). Drive out pin (17) and remove drive gear (18) and key (19). Pull drive shaft and gear (20) from pump body (21).

13-28. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air.

b. Clean all remaining gasket material from parts.

13-29. Inspection

Check the drive gear on the oil pump drive shaft for wear, cracks or chipped teeth.

Note. In no case should a new oil pump drive gear be used with a proferal type camshaft. The proferal type gear may be identified by the darker color.

13-30. Repair and Replacement

a. Refer to checks during disassembly.

b. Refer TM 5-3810-294-34P for repair parts.

13-31. Reassembly and Installation

Refer to figure 13-5 and reassemble and install oil pump and pan as follows.

a. Insert drive shaft and gear (20) into pump body (21).

b. Install key (19) in drive shaft (20). Press drive gear (18) onto the drive shaft 2 15/16 inch dimension from the top of the gear to the end of the shaft. Lock the gear on the shaft with pin (17).

c. Place idler shaft (16) and idler gear (15) in pump body (21).

d. Lubricate the gears and cams with engine oil, and install gasket (14) and cover (13) on the pump body and secure with capscrews (11) and washers (12).

e. Install oil screen (10) and pin (9).

f. Position oil pump mounting gasket (8) over the mounting holes in the block and lift oil pump into place. Aline pump with block for free movement of oil pump shaft. Secure with capscrews (6) and lockwashers (7).

g. Install gasket (5) and position pan (4) in place, and secure with capscrews (3). Install gasket (2) and drain plug (1).

Section VI. REPAIR OF CRANKSHAFT, CAMSHAFT AND PISTON RINGS

13-32. Description

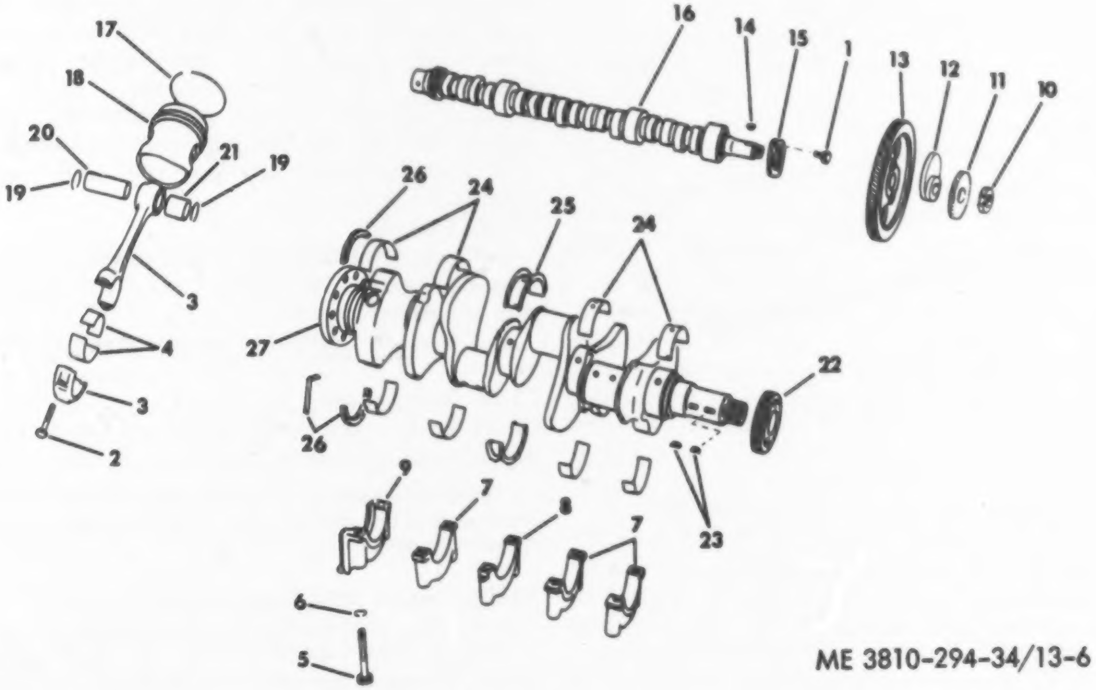
a. The camshaft controls the action of the intake and exhaust valves. The camshaft bearings are pressure lubricated and have oil holes drilled in them. These oil holes must be alined with the holes in the crankcase.

b. The crankshaft is the power linkage between the pistons and the power train. It is counterbalanced; and is supported by five steel backed babbitt main bearings. The middle bearing, (item 25, fig. 13-6) absorbs the crankshaft end-thrust.

c. The connecting rods are forged steel with bronze bushings at the upper ends. Rod caps are not interchangeable and are numbered for identification. The pistons are aluminum alloy, tin plated with hand ground solid skirts.

13-33. Removal

Refer to figure 13-6 and remove camshaft, pistons, and crankshaft as follows.



1. Capscrew (2)
2. Rod bolt (16)
3. Connecting rod (8)
4. Rod bearing (8)
5. Bolt (10)
6. Washer (10)
7. Bearing cap (3)
8. Bearing cap
9. Bearing cap
10. Jam nut
11. Distributor gear
12. Fuel pump cam
13. Gear
14. Key
15. Thrust plate
16. Camshaft
17. Piston ring set (8)
18. Piston (8)
19. Retaining ring (16)
20. Piston pin (8)
21. Sleeve bearing
22. Crankshaft gear
23. Key (2)
24. Bearing set (4)
25. Thrust bearing set (1
26. Seal
27. Crankshaft

Figure 13-6. Camshaft, pistons, and crankshaft, exploded view.

a. Remove valve cover, rocker arm and shaft assembly, and pushrods. Remove valve lifters, oil pan, oil pump and gear cover. Remove capscrews (1), and remove camshaft assembly.

b. With both heads removed, rotate the shaft to position the journals for removal of the rods.

Note. Remove the ridge from the top of the cylinder bore. Mark all pistons, rods and bearing caps for replacement in the same cylinder bore.

c. Remove rod bolts (2), rod caps (3), and rod bearing half (4). Push pistons and rod assembly through the top of the block.

d. Remove main bearing bolts (5), washer (6), and bearing caps (7, 8, and 9).

e. Lift crankshaft straight up and out of engine.

13-34. Disassembly

Refer to figure 13-6 and disassemble camshaft, pistons, and crankshaft as follows.

a. Remove jam nut (10), distributor gear (11), fuel pump cam (12), and gear (13). Remove key (14) and thrust plate (15).

b. Using a piston ring expander, remove the piston ring set (17). Remove top ring first and remaining rings in order.

c. Heat piston (18) in boiling water or a piston heater. Position the piston and rod assembly in a piston vise and remove the piston pin retainers (19) and drive pin (20) from the bore. Press out bearings (21) from rod (3).

d. Using a gear puller, remove crankshaft gear (22). Remove key (23) and bearing set (24 and 25), and seal (26) from crankshaft (27).

13-35. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly. Remove all carbon and corrosion from engine parts. Clean remaining gasket material from engine parts.

b. Clean bearings carefully in solvent and allow to dry. Do not use compressed air to dry bearings. Coat bearings in engine oil immediately after drying. Clean all oil holes and passages with brass probes.

c. Clean piston and piston pins in cleaning solvent.

Note. Do not use a caustic solvent for cleaning aluminum pistons.

13-36. Inspection

a. Inspect camshaft journal for evidence of wear or out of round. Refer to table 1-4 for wear limits.

b. Check the oil pump drive gear on the rear of the camshaft. If teeth are worn or damaged, the camshaft must be replaced because the gear is integral with the shaft.

c. Inspect camshaft lobes. Inspect camshaft bearings for wear and proper running clearance.

d. Inspect piston for scuffed, marred, or scored skirts and cracked or worn piston ring lands.

e. Examine piston pins for wear, corrosion, or etching, and replace if any of these are evident.

f. Inspect connecting rods and rod bushings for wear, cracks, pits, etc.

g. Aline connecting rods using a connecting rod mandril. Place the rod flat in the mandril to check for any malformation by inserting feeler gages between the rod and mandril. A malformation of 0.004 inch or greater is cause for rejecting the rod.

h. Inspect the crankshaft for cracked, scored, grooved or worn main bearing journals. If the journals show wear or out of round in excess of 0.002 inch, the crankshaft should be reground and undersize bearing installed or replaced. Refer to table 1-4 for journal diameters.

i. Examine crankshaft timing gear teeth and replace the gear if the teeth are worn or damaged.

Note. The crankshaft gear and the timing gear on the camshaft are matched sets. When one is replaced, both must be replaced.

j. Inspect crankshaft bearing for wear and evidence of uneven bearing support. If such evidence is present, examine the bearing caps for high spots or burrs.

13-37. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace all worn or chipped gears. Replace camshaft if lobes are cracked, worn, pitted, etc.

c. Replace all bearings that reveal badly worn or scored areas. Check all parts against values shown in table 1-4.

13-38. Reassembly and Installation

Refer to figure 13-6 and assemble and install camshaft, pistons and crankshaft as follows.

a. Turn the block on the stand so that the bottom faces upward. Position the rear main bearing upper seal (26) in the groove in the block.

b. Install key (23) in crankshaft (27). Press gear (22) onto crankshaft.

c. Lubricate the block half of bearings (24 and 25). Place the bearing shell halves in the bore of the block. Be sure that the oil holes in bearing shells line up with the oil holes in the block, and that the locking tangs on the bearings fit into the recesses. Follow the same procedure and place the bearing shell halves in the bearing caps (7 and 8).

d. Place crankshaft into crankcase. Install oil seal (26) into the recesses of the rear main bearing cap. The overhanging lip on the front of this seal must be toward the rear of the engine.

Note. The words "left" and "right " are stamped on the feet of the seals, and the foot of the right seal is yellow. The words "left and "right" refer to the right or left side of the engine as viewed from the flywheel end of the engine.

e. Place bearing caps and bearing lower halves over the crankshaft journals. Be sure that the bearing caps are properly installed with the number toward the right side of the crankcase.

f. Install cap bearing bolts (5) and washers (6). Tighten the bearing caps although not to full torque. Using a soft hammer, tap rear bearing cap until the rear machine face of the cap is flush with the rear machine face of the crankcase. Alinement of these two faces will assure proper cap location. Tighten main bearing cap bolts to torque of 105 foot-pounds.

g. Press sleeve bearing (21) into rod bore. Heat piston (18) to approximately 200 degrees F in a piston heater or boiling water. With the palm of the hand, push piston pin (20) through piston and bearing sleeve. Install retaining rings (19).

h. Using piston ring expander tool, assemble rings (17) on piston, bottom ring first.

i. Turn the crankshaft so the number 1 crankpin is at bottom dead center. Coat the piston bores, crankshaft journals, pistons, piston rings and piston pins with engine oil. Using a ring compressor, install the piston assembly into its respective cylinder bore with the word "up" marked on the piston toward the center line of the cylinder block. Install rod bearings (4) and caps (3), coating each bearing shell with engine oil. The numbered side of the caps must match and be on the numbered side of the rod. Install rod bearing bolts (2) and torque to 65 foot-pounds.

Note. If the rods and bearing caps are properly installed, the large chamfered side of the rod and the cap will be to the fillet side of the crank pin.

j. Install key (14), thrust plate (15) and press gear (13) into place on camshaft (16). Coat the cam lobes with heavy duty axle lubricant. Insert camshaft (16) through the front end of the block. Be sure that the timing marks on the camshaft and crankshaft line up. Secure with capscrews (1).

k. Install fuel pump cam (12), distributor gear (11) and jam nut (10) on camshaft.

l. Using a dial indicator, check the camshaft end play. If the end play exceeds limits shown in table 4-1, replace the camshaft thrust flange.

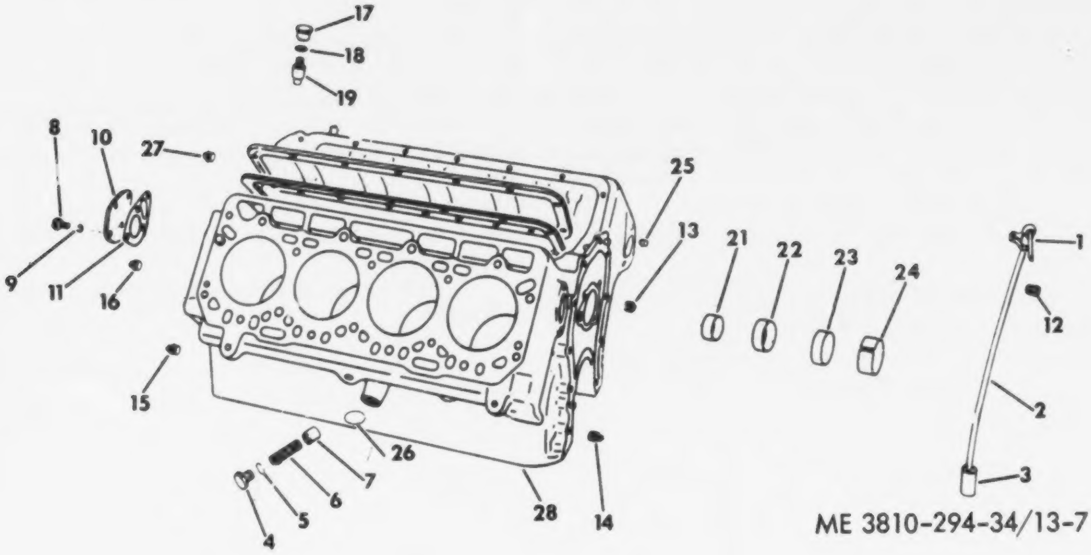
Section VII. REPAIR OF CRANKCASE

13-39. Description

The crankcase contains the crankshaft, camshaft and sleeves. This section assumes removal of all mechanisms in this chapter up to this point.

13-40. Disassembly

Refer to figure 13-7 and disassemble as follows.



1. Dipstick
2. Tube
3. Lower gage tube
4. Valve plug
5. Gasket
6. Spring
7. Valve piston
8. Capscrew (4)
9. Lockwasher (4)
10. Cover
11. Gasket
12. Plug
13. Plug (4)
14. Plug (2)
15. Plug (2)
16. Plug (4)
17. Bearing cap
18. Gasket
19. Upper bearing
20. Pin (4)
21. Bearing
22. Bearing
23. Bearing
24. Bearing
25. Pin (2)
26. Expansion plug (7)
27. Plug
28. Crankcase

Figure 13-7. Crankcase, exploded view.

a. Remove dipstick (1), dipstick tube (2) and lower gage tube (3).

b. Remove valve plug (4), gasket (5), spring (6), and valve piston (7).

c. Remove capscrews (8), lockwashers (9), camshaft cover (10) and gasket (11).

d. Remove plugs (12, 13, 14, 15 and 16).

e. Remove bearing cap (17), gasket (18), and upper bearing (19). Remove pin (20).

f. If camshaft bearings show evidence of wear they can be replaced. Remove bearings (21, 22, 23 and 24) using a bushing remover.

g. Remove pins (25). Expansion plugs (26) should not be removed unless it shows evidence of leakage.

13-41. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly.

b. Clean all carbon or corrosion from engine parts. Remove all remaining gasket material from parts.

c. Clean bearings carefully in solvent and allow to dry. Do not use compressed air to dry bearings. Soak bearings in oil immediately after drying.

d. Clean all oil holes and passages with brass probes. Flush passages and dry with compressed air.

13-42. Inspection

Inspect sleeve bores for scores, mars, etc. Inspect bearings for wear, out of round, scratches, or scoring.

best copy available

13-43. Repair and Replacement

a. Refer to TM 5-3810-294-34P for repair parts.

b. Replace damaged covers.

c. Replace cam bearings if defective.

d. Repair minor cracks in crankcase by welding.

e. Replace studs if loose or if threads are damaged.

f. Remove score marks and scratches from machined surfaces of crankcase. Retap damaged threads in tapped holes. Plane block if warped. (Refer to table 1-4 for planning limits.)

g. Check all parts against tolerances shown in table 1-4.

13-44. Reassembly and Installation

Refer to figure 13-7 and install as follows.

a. Press camshaft bearings (21, 22, 23 and 24) in crankcase bores.

b. Install pins (25) and plugs (26 and 27). Install pins (20).

c. Press upper bearing (19) into block bores. Install gasket (18) and bearing cap (17). Install plugs (12, 13, 14, 15 and 16).

d. Assemble gasket (11) and cover (10) and mount on crankcase with capscrews (8) and lockwashers (9).

e. Assemble valve piston (7) and spring (6) and install in crankcase side. Install gasket (5) and valve plug (5).

f. Install lower gage tube (3), tube (2) and dipstick (1).

CHAPTER 14

REPAIR OF CLUTCH CONTROL, TRANSMISSION, AND CLUTCH ASSEMBLIES

Section I. REPAIR OF CLUTCH CONTROL

14-1. Description

Depressing the clutch pedal forces the clutch release bearing toward the engine and retracts the pressure plate. When the pressure plate is retracted, pressure is relieved from the intermediate plate and the disc assembly which disengages the clutch. Releasing the clutch pedal allows the release bearing to move toward the transmission permitting the pressure plates and center drive plates to engage.

14-2. Removal and Disassembly

Refer to figure 14-1, and remove and disassemble clutch control components to the extent necessary for replacement of damaged parts.

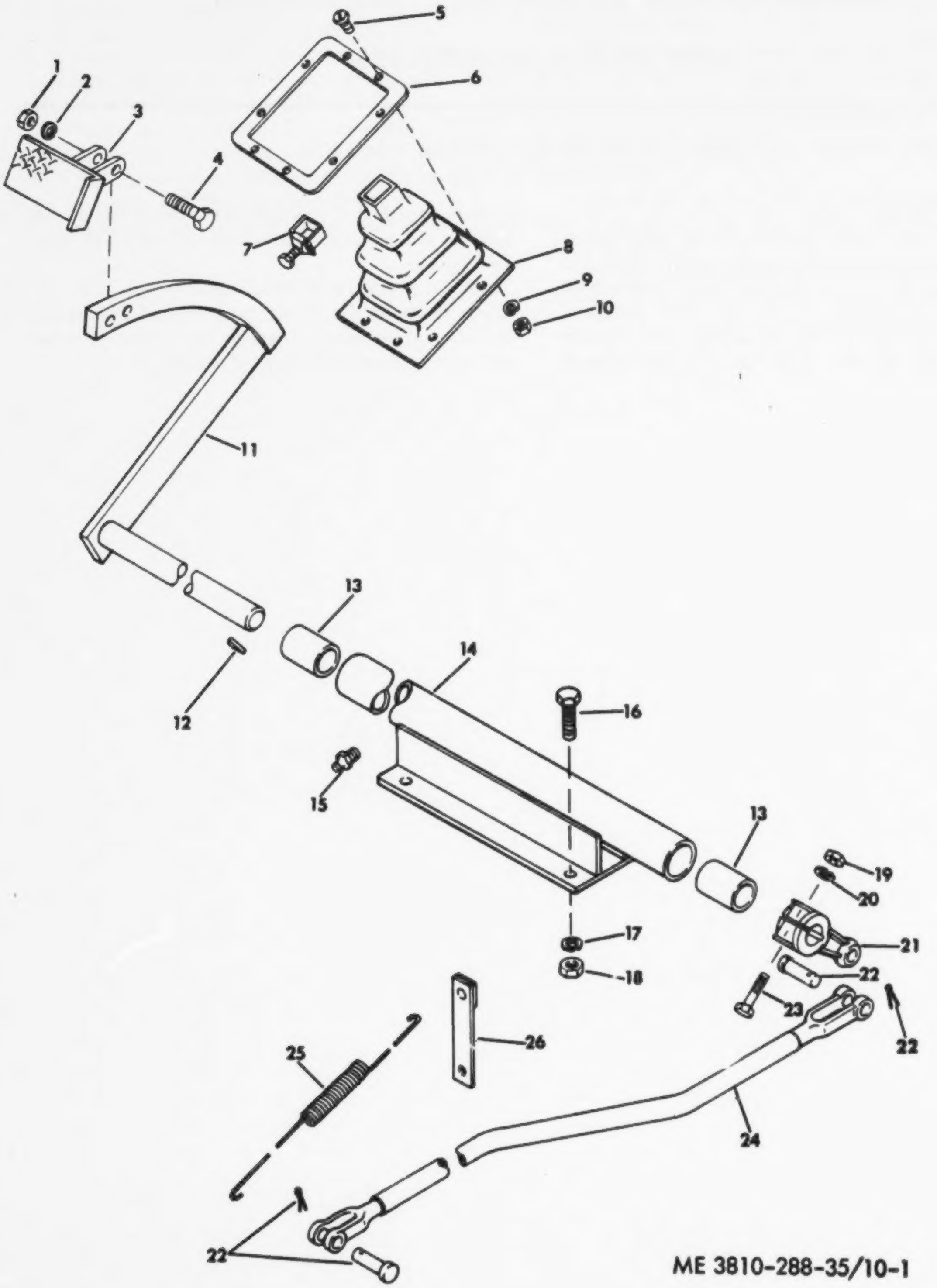

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
13
13
19
20
21
17
18
22
23
22
25
26
24
22
ME 3810-288-35/10-1

Figure 14-1. Clutch control, exploded view.

KEY to fig. 14-1.
1. Nut (2)
2. Lockwasher (2)
3 Pedal
4. Capscrew (2)
5. Screw (8)
6. Plate
7. Clamp
8. Boot
9. Lockwasher (8)
10. Nut (8)
11. Clutch pedal shaft
12. Woodruff key
13. Bushing (2)
14. Bracket
15. Lubrication fitting
16. Capscrew (4)
17. Lockwasher (4)
18. Nut (4)
19. Nut
20. Lockwasher
21. Lever
22. Yoke pin assembly
23. Capscrew
24. Rod
25. Spring
26. Spring clip

14-3. Cleaning, Inspection and Repair

a. Clean all parts with an approved cleaning solvent.

b. Inspect for wear or damage, and replace all defective parts.

14-4. Reassembly and installation

Refer to figure 14-1, and reassemble and install clutch control components.

14-5. Adjustment

Adjust clutch control linkage (refer to TM 5-3810-294-20).

Section II. REPAIR OF TRANSMISSION ASSEMBLY

14-6. Description

The carrier transmission has five forward speeds and one reverse speed. However, with the drop gear unit, two transmission speeds are available for each transmission shift lever position outside first gear. The total available speeds are, therefore, nine forward and two reverse.The complete carrier transmission assembly includes the main transmission, a remote control assembly, a manual control assembly, and a drop gear unit.

14-7. Removal

Refer to paragraph 11-9 and remove transmission assembly

14-8. Disassembly

a. Refer to figure 14-2 and disassemble the remote control assembly as follows:

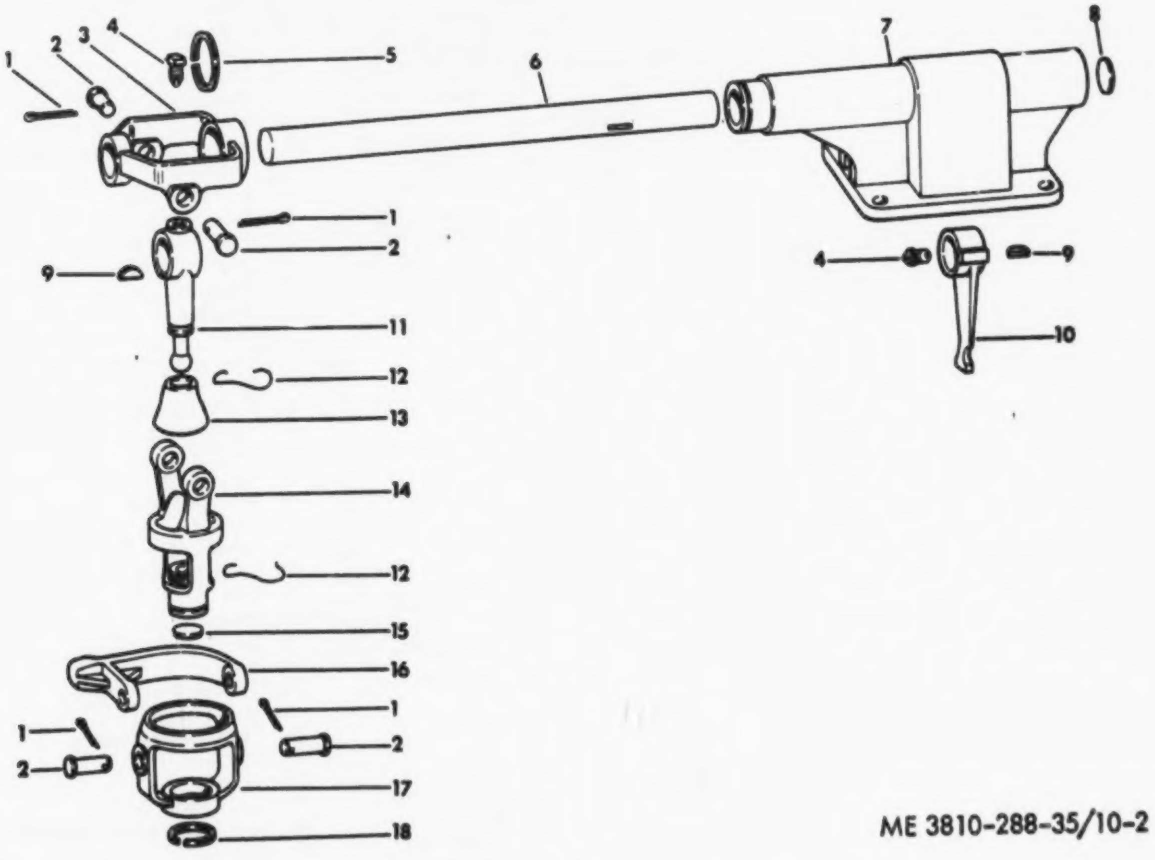


Figure 14-2. Remote control assembly, exploded view.

KEY to fig. 14-2.
1. Cotter pin (6)
2. Clevis pin (6)
3. Bracket
4. Lock screw (2)
5. Retaining ring
6. Shaft
7. Control top
8. Welch plug
9. Woodruff key (2)
10. Shift finger
11. Shift finger
12. Lock wire
13. Boot
14. Lever
15. Welch plug
16. Yoke
17. Swivel bracket
18. Retaining ring

(1) Remove remote control assembly from the manual control assembly.

(2) Remove retaining ring (18, fig. 14-2). Remove yoke (16) and swivel bracket (17) as an assembly. Remove two cotter pins (1) and two clevis pins (2).

(3) Remove locking screws (4) and woodruff keys (9) from both shift fingers (10 and 11). Remove rocker shaft (6).

(4) When clevis pins (2) and cotter pins (1) (used with fingers 10 and 11) are removed, the universal lever (14), outside shift finger (11), and boot (13) are accessible. Cut lockwire (12).

(5) Remove retaining ring (5) only if it is necessary to replace pivot anchor bracket (3).

b. Remove fourteen screws and lockwashers that secure the manual control assembly (fig. 14-4) to the transmission housing and remove manual control assembly.

c. Shifting by hand, engage transmission into two speeds at the same time.

d. Remove companion flange nut (29, fig. 14-5).

e. Remove drop gear unit (fig. 14-5) by removing nuts (63) and lockwashers (62).

f. Refer to figure 14-3 and remove cotter pin (31), nut (32), and washer (33). Remove drop gear (34).

KEY to fig. 14-3.
1. Bearing cap
2. Gasket
3. Nut
4. Bearing
5. Drive gear
6. Screw (2)
7. Throw out yoke
8. Shaft
9. Clutch housing
10. Cover plate
11. Lockwasher (2)
12. Capscrew (2)
13. Bushing (4)
14. Shaft
15. Gasket
16. Stud (4)
17. Lockwasher (4)
18. Nut (4)
19. Cover plate
20. Gasket
21. Gasket
22. Thrust washer
23. Bearing
24. Bearing spacer
25. Bearing
26. Idler gear
27. Thrust washer
28. Idler shaft
29. Lock plate
30. Screw and washer assembly
31. Cotter pin
32. Nut
33. Washer
34. Gear
35. Oil seal
36. Capscrew (6)
37. Bearing
38. Washer (6)
39. Bearing cap
40. Gasket
41. Bearing cup
42. Retaining ring
43. Spacer
44. Bearing
45. Shim
46. Fill plug
47. Gear
48. Mainshaft
49. Bushing
50. Pin
51. Gear and bushing assembly
52. Washer
53. Retaining ring
54. Synchronizer assembly
55. Thrust washer
56. Gear and bushing assembly
57. Washer
58. Bushing
59. Pin
60. Gear and bushing assembly
61. Washer
62. Retaining ring
63. Synchronizer assembly
64. Bearing
65. Welch plug
66. Retaining ring
67. Bearing
68. Spacer
69. Retaining ring
70. Gear
71. Spacer
72. Gear
73. Gear
74. Woodruff key (3)
75. Countershaft
76. Transmission housing
77. Pipe plug
78. Gasket
79. Cover plate
80. Screw and washer assembly (12)
81. Bearing
82. Spacer
83. Nut

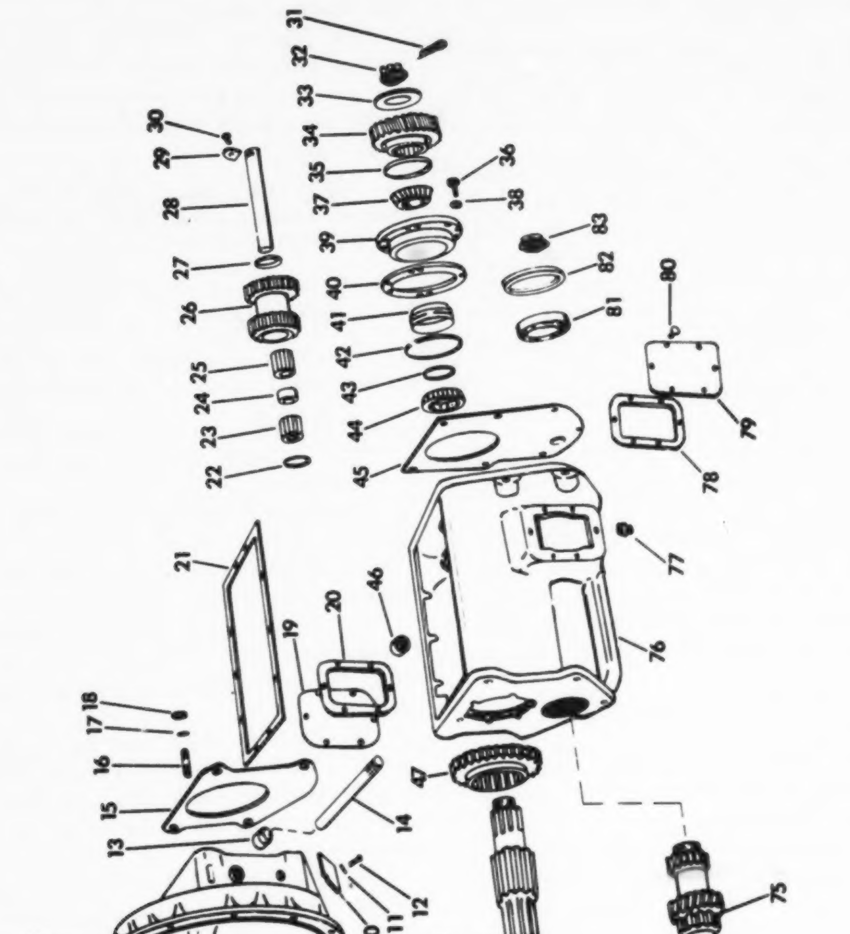

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83

Figure 14-3. Carrier transmission exploded view.

g. Break lockwire and remove capscrews (36), washers (38) and bearing cap (39).

Note. Use puller screws to remove bearing and bearing cap. Mainshaft (48) can be removed from housing without removing main drive gear (5), as described in steps i and j below.

h. Remove clutch throw out yoke (7) by removing screws (6) and pulling shafts (8 and 14) out of clutch housing (9). Remove main drive gear bearing cap (2) attaching hardware. Strike the gear end of main drive gear (5) with a brass bar and mallet to remove bearing cap (1), gasket (2), nut (3), and bearing (4) as a unit, mounted on drive gear (5).

i. Push mainshaft assembly (48) toward rear of housing (76).

j. Tilt the forward end of mainshaft (48) upward at the front of housing and remove the entire assembly.

k. Remove reverse idler lockscrew (30) and lock plate (29). Using a suitable puller, remove idler shaft (28). The reverse idler gear (26), thrust washers (22 and 27), bearings (23 and 25), and spacer (24) come out when idler shaft (28) is removed.

l. Remove nut (83). Remove countershaft rear bearing spacer (82).

m. Push countershaft (75) toward rear of transmission housing so that bearing (81) can be removed from the countershaft.

n. Remove the countershaft assembly by tilting the forward end upward.

o. Remove bearing (67) using a bearing puller.

p. Disassemble the mainshaft assembly as follows:

(1) Remove inboard half of inner race of bearing (44). Use puller on first and reverse gear (47).

(2) Place balance of assembly in vise using copper or lead jaws so as not to damage splines. Place pilot end of mainshaft (48) upward.

(3) Using a suitable puller, remove bearing (64).

(4) Remove fourth and fifth synchronizer (63).

(5) Remove retaining ring (62), washer (61), and gear (60).

(6) Remove fourth gear bushing (58), lock pin (59), locating washer (57), and third gear (56).

Note. If bushing (58) slips off without a puller, it should be replaced. Pin (59) is located between bushing and shaft. Do not lose pin (59).

(7) Remove thrust washer (55) and second and third synchronizer (54).

(8) Remove retaining ring (53), locating washer (52), and second gear (51).

(9) To remove second gear bushing (49) from shaft, use a brass or bronze punch and tap lightly with mallet.

Note. Do not remove bushing (49) unless it is to be replaced. Retaining pin (50) is located between bushing (49) and mainshaft (48). Do not lose pin.

q. Remove and disassemble the clutch housing and bushing assembly as follows:

Note. It is recommended that the clutch housing be removed only if replacement of same is required.

(1) Remove nuts (18) and lockwashers (17).

(2) Disassemble main drive gear as described in steps below.

r. Disassemble the countershaft assembly as follows:

(1) Remove locating spacer (68) and retaining ring (69).

(2) Remove plug (65) and retaining ring (66). Press gear (70) from shaft (75). Do not remove plug (65) and retainer (66) unless they are to be replaced.

(3) Remove drive gear key (74), drive gear spacer (71), fourth gear (72), and third gear (73).

(4) Remove remaining gear keys (74).

s. Disassemble the main drive gear and bearing assembly as follows:

(1) Place gear (5) in a copper jawed vise.

(2) Destake nut (3) using a small chisel in the slot. Using a suitable wrench, remove the nut.

(3) Using suitable puller or arbor press, remove bearing (4) from gear.

t. Disassemble mainshaft rear bearing cap assembly as follows:

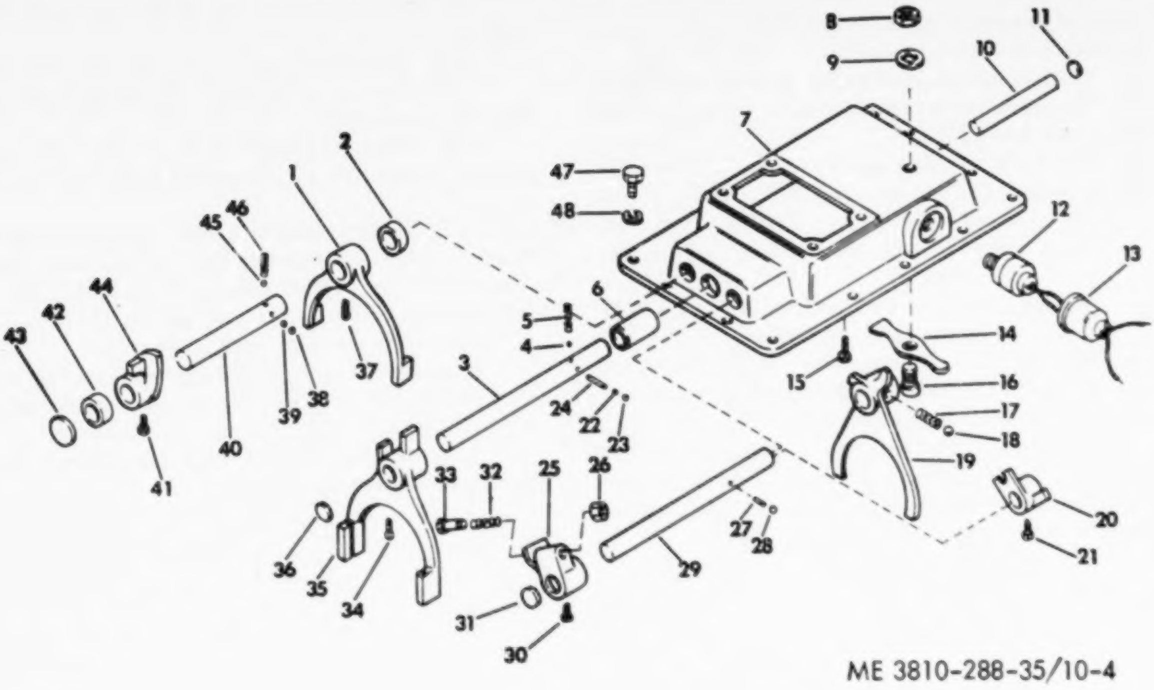
(1) Remove retaining ring (42) from bearing cap (39).

(2) Place bearing cap (39) in arbor press with cap resting on flange.

(3) Press on inner race of bearing (37) to remove it from bearing cap (39).

(4) Using a punch, drive out oil seal (35) and discard.

u. Refer to figure 14-4, and disassemble the manual control assembly as follows:


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
ME 3810-288-35/10-4

1. Shift fork
2. Spacer
3. Shift rail
4. Poppet balls
5. Spring
6. Spacer
7. Housing
8. Nut
9. Lockwasher
10. Shift fork bar
11. Welch plug
12. Switch
13. Boot
14. Rocker arm
15. Setscrew
16. Screw
17. Spring
18. Poppet
19. Shift fork
20. Rocker lug
21. Setscrew
22. Interlock ball
23. Interlock ball
24. Pin
25. Shift lug
26. Nut
27. Pin
28. Interlock ball
29. Shift rail
30. Setscrew
31. Welch plug
32. Spring
33. Plunger
34. Setscrew
35. Shift fork
36. Welch plug
37. Setscrew
38. Interlock ball
39. Interlock ball
40. Shift rail
41. Setscrew
42. Spacer
43. Welch plug
44. Shift lug
45. Poppet ball
46. Spring
47. Screw (14)
48. Lockwasher (14)

Figure 14-4. Manual control assembly, exploded view.

(1) Each rail, shift fork, and lug must be properly tagged to show its position in housing (7) to ensure correct reassembly.

(2) Remove neutral switch (12) from housing.

(3) Remove neutral switch actuating ball (28), and pin (27).

(4) Turn housing upside down and remove welch plugs (11, 31, 36, and 43).

(5) Shift all rails into neutral position, then remove all shift lug lockwires and set screws (41, 37, 34, 30, 21, and 15).

(6) Remove first and reverse shift rail (29).

(7) Remove first and reverse rocker lug (20) and shift lug (25). Remove nut (26), spring (32), and plunger (33) only if replacement is necessary.

(8) Remove fourth and fifth shift rail (3).

Caution: **Be sure to hold over poppet hole in rail support to prevent loss of poppet balls and spring as rail is removed. Caution should be used not to lose pin (24).**

(9) Remove fourth and fifth shift fork (35) and spacer (6).

(10) Remove second and third shift rail (40).

(11) Remove second and third shift fork (1), lug (44), and spacers (2 and 42).

(12) Remove poppet balls (4 and 45), and springs (5 and 46), and interlock balls (22, 23, 38, and 39).

(13) Remove shift fork bar (10) by driving on interior end of bar with a punch and hammer. Place hand over the poppet hole in shift fork (19) to prevent loss of ball (18) and spring (17).

(14) Remove shift fork (19).

(15) Remove first and reverse rocker arm (14). Screw (16), washer (9) and nut (8) should be removed only if replacement is necessary.

v. Refer to figure 14-5 and disassemble drop gear unit as follows:

Key to fig. 14-5
1. Capscrew (10)
2. Lockwasher (10)
3. Cover plate
4. Gasket
5. Capscrew (8)
6. Lockwasher (8)
7. Cover plate
8. Hose
9. O-ring
10. Retaining ring
11. Piston
12. Solenoid valve
13. Sealing ring
14. Air shift cylinder
15. Hose
16. O-ring
17. O-ring
18. Lock screw
19. Shift fork assembly
20. O-ring
21. High-low shift rod
22. Spacer
23. Gasket
24. Adaptor
25. Lockwasher (4)
26. Capscrew (4)
27. Welch plug
28. Cotter pin
29. Nut
30. Washer
31. Oil seal
32. Capscrew (8)
33. Lockwasher (8)
34. Bearing cover
35. Gasket
36. Spacer
37. Retaining ring
38. Bearing
39. Bearing
40. Air breather assembly
41. 45° street elbow
42. Filler plug
43. Housing
44. Output shaft
45. Thrust washer
46. Bushing
47. Pin
48. Gear
49. Shift hub sleeve
50. Synchronizer assembly
51. Bushing
52. Pin
53. Gear
54. Thrust washer
55. Bearing
56. Nut
57. Baffle
58. Lockwasher (4)
59. Capscrew (4)
60. Drain plug
61. Stud (8)
62. Lockwasher (8)
63. Nut (8)
64. Intermediate shaft
65. Locating ring
66. Gear
67. Thrust washer
68. Bearing
69. Retaining ring

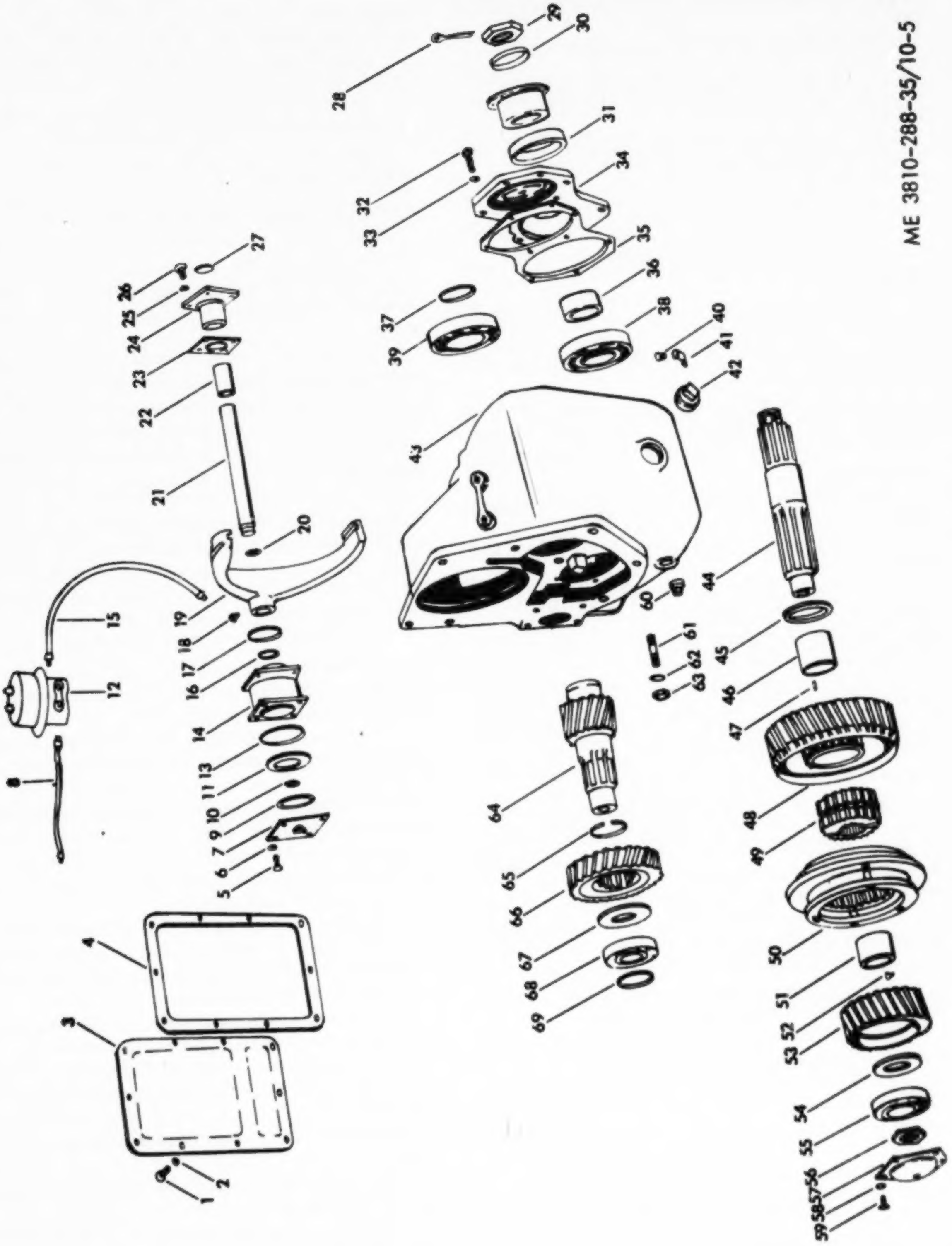

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
ME 3810-288-35/10-5

Figure 14-5. Drop gear unit, exploded view.

(1) Remove air solenoid valve (12) and hoses (8 and 15). Remove capscrews (1) and lockwashers (2).

(2) Remove cover (3) and gasket (4).

(3) Remove lockwire and lock screw (18).

(4) Remove capscrews (26) and lock washers (25).

(5) To remove shift rod adapter (24), tap lightly on adapter from inside of housing.

(6) Remove air shift cylinder housing mounting bolts (5) and washers (6).

(7) Remove air shift cylinder (14).

(8) Remove high low shift fork (19) and spacer (22).

(9) Remove capscrews (59) and lockwashers (58), then remove baffle (57).

(10) Remove nut (56). This nut is staked, and must be unstaked.

(11) Hold onto companion flange (located between items 30 and 31) with pipe wrench. Remove companion flange nut (29), washer (30), and flange.

(12) Remove capscrews (32) and lockwashers (33).

(13) Remove rear bearing cover (34) and gasket (35).

(14) Using brass or bronze bar, drive the output shaft (44) through the rear bore. The low gear bushing (46), lock pin (47), thrust washer (45) and bearing (38) will remain on the shaft.

(15) The high gear thrust washer (54), high gear (53), high gear bushing (51), lock pin (52), high low synchronizer (50), hub (49) and low gear (48), may be removed from the housing as a unit. Use caution not to lose lock pin (52).

(16) To finish disassembling output shaft (44), use a suitable puller to remove bearing (38), or place the shaft in an arbor press with the threaded end up, and remove the bearing. Then remove thrust washer (45), bushing (46), and lock pin (47). To remove bushing (46), block under thrust washer (45) and press off the opposite end of bearing (38). Use caution not to lose lock pin.

(17) To remove output shaft front bearing (55), press out through bore of housing.

(18) To remove intermediate shaft (64), remove rear bearing retainer ring (37).

(19) Drive on the front of intermediate shaft (64) with brass or bronze bar until back bearing comes completely out of bore in housing. Using a suitable puller, remove bearing (39).

(20) After bearing is removed, shaft can be tilted and removed through control cover (3) opening.

(21) Press oil seal (31) from rear bearing cap (34). This should be done only if seal is defective and needs replacing.

(22) Remove retaining ring (69).

(23) Place intermediate shaft (64), in an arbor press and remove gear (66), thrust washer (67), and bearing (68). Remove locating ring (65).

(24) Remove capscrews (5), washers (6), cover (7), and O -ring (9).

(25) Remove retaining ring (10), then press on end of shaft (21) to remove piston (11).

(26) Remove sealing ring (13) and O -rings (16, 17, and 20).

14-9. Cleaning, Inspection, and Repair

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect all transmission parts for wear or damage. Replace all excessively worn or damaged parts.

c. Inspect gear teeth for wear, cracks, or pitting on tooth faces. Replace worn or defective gears.

d. Check axial gear clearance. If excessive axial movement is evident, check gear retaining rings, washers, spacers, and gear hub wear. Replace all worn parts.

e. Inspect all splines for excessive wear. Replace any part which has worn or damaged splines.

f. Inspect grey iron parts for cracks and fractures. Replace or repair damaged parts. Castings may be welded or brazed if cracks do not extend into bearing bores or bolting surfaces.

g. Replace all O, -rings and gaskets.

14-10. Reassembly

a. Refer to figure 14-3, and assemble the mainshaft assembly as follows:

(1) Clamp mainshaft (48) into a vise using copper or lead jaw shields. Be sure pilot end of shaft is up.

(2) Using a suitable driving tool, install second gear bushing (49), on mainshaft. Install retaining pin (50) toward top of shaft.

(3) Place second gear (51) on shaft, with toothed hub of gear up.

(4) Place retaining washer (52) on shaft. If gear (51) has been replaced, select proper retainer washer (one of three) to get proper end play, which is from 0.006 to 0.013 inch.

(5) Place new retaining ring (53) on shaft.

(6) When placing synchronizer assembly (54) on shaft, note that one side of the hub is undercut for second gear retaining washer (52). Place this side down.

(7) Place third gear thrust washer (55) on shaft.

(8) Put third gear (56) on shaft with toothed hub of gear down.

(9) Place locating washer (57) on shaft.

(10) Using a suitable driving tool, install fourth gear bushing (58) on shaft. Install bushing (58) with retaining pin (59) toward top of shaft.

(11) Place fourth gear (60) on shaft with toothed hub of gear up.

(12) Place fourth gear retaining washer (61) on shaft. If gear (60) has been replaced, select proper retaining washer (one of three) to get proper end play, which is from 0.006 to 0.013 inch.

(13) Place fourth gear retaining ring (62) on shaft.

(14) Place fourth and fifth synchronizer assembly (63) on shaft. One side of shift hub is undercut for fourth gear locating washer. Place this side down.

(15) Press bearing (64) on shaft.

(16) Install first and reverse sliding gear (47) on shaft with fork slot away from threaded end.

(17) Press tapered bearing (44) onto mainshaft.

b. Refer to figure 14-3 and assemble the countershaft assembly as follows:

(1) Install rear woodruff key (74) into the rear slot in countershaft (75).

(2) Press countershaft third gear (73) onto shaft.

(3) Install center woodruff key, and press countershaft fourth gear (72) onto shaft. The longer hub on gear must be facing away from threaded end of shaft.

(4) Place countershaft drive gear spacer (71) on shaft.

(5) Install the remaining woodruff key, and press countershaft drive gear (70) onto shaft. The longer hub on gear should be facing toward threaded end.

(6) Install countershaft drive gear retaining ring (69) of shaft on end of shaft.

c. Refer to figure 14-3 and assemble the main drive gear and bearing assembly as follows:

(1) Assemble bearing (4) on main drive gear (5) with retaining ring toward the pilot end of the gear.

(2) Assemble nut (3) and tighten securely.

(3) Stake nut (3) in place.

d. Refer to figure 14-3 and assemble and install clutch housing and bushing assembly, if removed and disassembled, as follows:

(1) Install studs (16) into clutch housing (9).

(2) Assemble clutch housing (9) and gasket (15) to transmission housing (76) and secure in place with lockwashers (17) and nuts (18).

(3) Install main drive gear (5) and bearing (4) assembly into housing (76).

(4) Install gasket (2) and bearing cap (1). Secure bearing cap with six lockwashers and capscrews.

(5) Install shafts (8 and 19) through side openings in clutch housing (9) and into throw out yoke (7). Install screws (6).

e. Refer to figure 14-3 and assemble the mainshaft rear bearing cap assembly as follows:

(1) Press bearing cup (41) into bearing cap (39). The bearing cup should be resting on rear of cap (39).

(2) Install new retaining ring (42).

f. Refer to figure 14-4 and assemble the manual control assembly as follows:

(1) Install first reverse rocker arm pivot screw (16). Install screw through from inside cover. Install a flat washer (not shown), lockwasher (9), and nut (8).

(2) Place shift bar housing (7) on the bench in an upside down position, with welch plug holes facing repairman.

(3) Place first reverse rocker arm (14) over pivot screw with long end to the right.

(4) Install shift fork bar (10) and shift fork (19) as follows:

(a) Using suitable tool, compress spring (17) with ball (18) in position in reverse fork (19) poppet hole.

(b) Place reverse fork in position, with poppet hole pointed toward left side of housing.

(c) Push shift fork bar (10) through opening in far end of cover housing and through fork.

(d) Tap on end of shift fork bar until setscrew hole in cover and hole in shaft are lined up.

(e) Place setscrew (15) in place and tighten securely.

(5) Install second-third shift rail (40), spacer (42), lug (44), fork (1), and spacer (2) as follows:

(a) Slide second-third shift rail (40) through opening on right.

(b) Place spacer (42) on rail.

(c) Place second-third shift lug (44) on rail, with setscrew opening up and shift slot toward center of housing.

(d) Place second-third shift fork (1) and spacer (2) on rail, with setscrew opening toward repairman.

(e) Place poppet spring (46) and ball (45) in poppet hole in cover.

(f) Using a suitable tool, compress spring (46) with ball (45) in position, and slide rail (40) through the rail support.

(g) Place setscrew (41) is shift lug (44) and setscrew (37) in shift fork (1). Tighten both securely.

(h) Shift into neutral position.

(6) Install first-reverse shift lug (25) and first-reserve rocker lug (20) as follows:

(a) Slide first-reverse shift rail (29) through opening on left.

(b) Place first-reserve shift lug (25) on rail

with setscrew opening up, and shift slot toward center of housing.

(c) Place interlock pin (27) in hole in shift rail with pin in rail in a horizontal position, push rail through rail support.

(d) Place first-reserve rocker lug (20) on end of rail with lock screw hole up and in position on rocker arm (14).

(e) Put setscrews (21 and 30) in place and tighten.

(f) Shift rail into neutral position.

(7) Install fourth-fifth shift rail (3) and shift fork (35) as follows:

(a) Slide fourth-fifth shift rail (3) through opening in center.

(b) Place fourth-fifth shift fork (35) and spacer (6) on rail with setscrew hole in fork away from repairman.

(c) Place two interlock balls (22 and 23) and (38 and 39) in cross holes in each rail support, on both sides of remaining opening.

(d) Place poppet spring (5) and ball (4) in poppet hole in housing.

(e) Using suitable tool, compress spring with ball in position.

(f) Place interlock pin (24) in hole in shift rail, with pin in rail in a horizontal position, push rail through.

(g) Place setscrew (34) in position and tighten.

(h) Shift rail into neutral position.

(8) Install lockwires into all screws. This should be done in a manner not to interfere with shifting.

(9) Check for proper assembly by shifting in and out of all speeds. Then shift center rail into fourth speed and attempt to shift side rails into speeds at same time. This provides a check on proper assembly of interlock plugs, balls, and pin.

Note. Assembly should not shift into more than one speed at a time.

(10) If assembly functions properly, install welch plugs (43, 36, 31, 11).

Note. Make sure welch plugs are aluminum.

(11) Turn assembly over.

(12) Check actuating pin (27) to see if it is in place; install interlock ball (28) and neutral switch (12).

g. Refer to figure 14-5 and assemble the drop gear unit as follows:

(1) If oil seal has been removed, press in a new oil seal (31).

(2) Assemble intermediate shaft (64) as follows:

(a) Install intermediate shaft gear locating ring (65).

(b) Press gear (66) on shaft with long hub toward the locating ring.

(c) Put thrust washer (67) on shaft; with oil grooves toward gear.

(d) Press bearing (68) on end of shaft, until bearing is seated against thrust washer (67).

(e) Install bearing retaining ring (69) on shaft (64).

(3) Assemble air shift cylinder body (14) as follows.

(a) Install new O -ring (20) on shift rod (21.

(b) Install piston (11) on rod (21), then place retaining ring (10) in place.

(c) Install new O -ring (16) and sealing ring (13) in cylinder (14).

(d) Insert rod (21) and piston (11) into cylinder (14).

(e) Install O -ring (9) and cover (7) on housing.

(f) Install capscrews (5) and lockwashers (6).

(g) Install new O -ring (17) on cylinder (14).

(4) Install intermediate shaft (64) through control cover opening on side of housing. Put shaft through rear bearing opening with front bearing lined up with bore. Drive shaft into place.

(5) Support front end of intermediate shaft (64) and drive rear bearing (39) into place using a suitable drive tool. Drive on inner race of bearing.

(6) Install intermediate shaft rear bearing retaining ring (37).

(7) Press output shaft rear bearing (38) on companion flange end of output shaft (44) until bearing is flush with shoulder on shaft.

(8) Place thrust washer (45) on shaft (44) with oil groove away from bearing.

(9) Using suitable driver, press bushing (46) on shaft with lock pin (47) away from thrust washer.

(10) Place output shaft low gear (48) on bench with toothed hub up. Check blocker pins on synchronizer to see that they show maximum staggering when synchronizer is examined standing on edge.

(11) Place shift hub sleeve (49) in synchronizer (50). Put synchronizer on gear with grooved ring in gear (48).

(12) Place output shaft high gear (53) on top of synchronizer with internal teeth down.

(13) Turn synchronizer (50) and gears (48 and 53) on side and roll into drop gear housing with gear (53) to the right side of the case.

(14) Turn housing over on its front so it is resting on studs (61).

(15) Center splines in synchronizer hub and gears so splines on shaft (44) can be installed. Rotate shaft until splines are lined up. Install shaft and rear bearing (38) into hole using proper driver.

(16) Install gasket (35) and cover (34) with capscrews (32) and lockwashers (33).

Note. Use sealing lead on threads of screws.

(17) Return assembly to horizontal position.

(18) Insert bushing (51) and lock pin (52) with lock pin toward front of case. Aline oil hole in bushing with hole in shaft.

***Caution:* Use extreme care when installing bushing (51) so as not to damage bushing in gear (53).**

(19) Place thrust washer (54) on shaft with oil groove facing the gear.

(20) Install output shaft front bearing (55).

(21) Install companion flange, flanged washer (30), and nut (29). Hold gear (48) with a pinch bar and torque nut to 500-600 foot-pounds.

(22) Place cotter pin (28) in shaft to secure nut in place.

(23) Install front bearing retainer nut (56).

(24) Hold gear (48) with a pinch bar and tighten retainer nut (56).

Note. Companion flange nut must be tightened before output shaft front bearing retainer nut.

(25) Install output shaft oil baffle (57), and capscrews (59) and lockwashers (58).

(26) Install high-low shift fork (19) with long hub or fork toward front of case.

(27) Install air shift cylinder with capscrews and lockwashers. Insert shaft through fork.

Note. Use sealing lead on threads of screws.

(28) Place spacer (22) on shift rod (21).

Note. Be sure holes in shaft and fork line up. Install lock screw (18) into fork and tighten. Install lockwire. Lockwire should be installed over right end of shift fork (19).

(29) Place shift rod adapter gasket (23) and adapter (24) over shaft, and insert in housing with oil drain hole in adapter down. Use capscrews (26) and lockwashers (25).

Note. Use sealing lead on threads of screws.

(30) Place control cover gasket (4) and control cover (3) on housing. Install capscrews (1) and lockwashers (2).

Note. Install the control cover with the rib at the bottom.

(31) Install air solenoid valve (12) and reconnect hoses (8 and 15).

h. Install countershaft front bearing (67, fig. 14-3). Be sure to apply pressure on outer race of bearing only.

i. Place countershaft front bearing spacer (68) in position on forward end of countershaft (75).

j. Tip rear end of countershaft down and lower into housing, running rear of countershaft bearing opening in rear of housing far enough so that the front of countershaft may be lowered into position.

k. Install countershaft rear bearing (81). Be sure that retaining ring is in position in the groove of the outer race of bearing. Press bearing into position on shaft with retaining ring toward rear.

l. Insert bearings (23 and 25) separated by spacer (24), into hub of reverse idler gear (26), and lower into position in case. The gear with chamfered teeth should be toward the rear of the case.

m. Insert reverse idler shaft (28) through hole in rear of case. Place thrust washers (22 and 27) with copper face toward the gear. Line up locating notches, then put shaft through gear (26) and into forward support boss. The shaft should be driven in until the forward face of slot in shaft is flush with rear face of housing and slot lined up to permit installation of lock plate (29).

n. Install lock plate (29) in end of shaft and secure with screw and lockwasher (30).

o. Install mainshaft assembly (48) in transmission housing. Tilt rear end of assembly down and lower into and through opening in rear of housing. Lower front end in line with pilot bearing opening, and move mainshaft assembly forward into position.

p. Install main drive gear and bearing assembly into opening in front of housing so that main drive gear engages and meshes with countershaft gear.

q. Install main drive gear bearing cap (1) and gasket (2).

***Caution:* Be sure oil return hole in cap is lined up with hole in housing. This passage must be open and clean.**

r. Install main drive gear bearing cap attaching hardware.

s. Install countershaft rear bearing spacer (82).

t. Install countershaft rear bearing retainer nut (83); tighten, and stake.

u. Using suitable driver, assemble inboard half of mainshaft rear bearing (44) over end of mainshaft (48).

v. Install drop gear housing shim (45). Use sealant on both sides of the shim.

w. Position mainshaft in housing.

x. Drive rear bearing cap (39) and gasket (40) onto mainshaft (48) until it is flush against case. Be sure oil passage openings in bearing cap line up with openings in housing.

Note. Install two studs in housing to keep bearing cap alined while it is pressed into housing.

y. Slip bearing spacer (43) on end of mainshaft.

z. Install capscrews (36) and washers (38) in rear bearing cap (39).

aa. Drive mainshaft rear bearing outer cone (37) on mainshaft (48), and into bearing cap (39).

ab. Drive in new oil seal (35), with the spring loaded lip of the seal toward the bearing.

ac. Place the drop gear (34) on mainshaft (48), and install washer (33), nut (32), and cotter pin (31).

ad. Install drop gear box on rear of transmission housing.

ae. Install nuts (63), fig. 14-5) flat washer (not shown) and lockwashers (62). Tighten nuts securely.

af. Install gasket (21, fig. 14-3). Shift transmission and manual control assembly into neutral, then install manual control assembly on transmission. The two short mounting bolts go in the back two corner holes of control housing. Tighten manual control assembly mounting hardware securely.

ag. Install drop gear unit and transmission drain plugs.

ah. Refer to figure 14-2 and reassemble the remote control assembly as follows:

(1) Clamp control top (7) upside down in a vise.

(2) If pivot anchor bracket (3) was removed, it should be reinstalled first and held in place by retaining ring (5).

(3) Place shift finger (11), with boot (13), in place in the universal lever (14).

(4) Hold shift finger and universal lever assembly in place. Slide rocker shaft (6) through bracket and shift finger.

(5) Install clevis pins (2) in pivot bracket (3). Secure with cotter pin (1).

(6) While holding inside shift finger in place, slide the shaft into place.

(7) Install woodruff keys (9) in rocker shaft, slide shift finger over woodruff key and secure the shift finger (11 and 10) with lockscrews (4) and lockwire.

(8) Place lockwire (12) on boot (13).

(9) Assemble draw rod yoke (16) in place over yoke swivel bracket (17), and install clevis pins (2). Secure with cotter pins (1).

(10) Assemble yoke assembly over universal lever (14) and secure with retaining ring (18).

ai. Install remote control assembly to transmission. Install and securely tighten the four mounting lockwashers and nuts.

14-11. Installation

Refer to paragraph 11-9 and install transmission assembly.

Section III. REPAIR OF CLUTCH ASSEMBLY

14-12. Description

The clutch assembly is mounted on the engine flywheel. The clutch driven disc assemblies are splined to the transmission main drive gear.

14-13. Removal

a. Refer to paragraph 11-9 and remove transmission.

b. Remove clutch assembly from engine flywheel.

14-14. Disassembly

Refer to figure 14-6 and disassemble clutch as follows:

a. Remove release sleeve and bearing assembly (19 through 29) as an assembly from spider (30) and disassemble as follows:

(1) Remove screws (19) and cover (20).

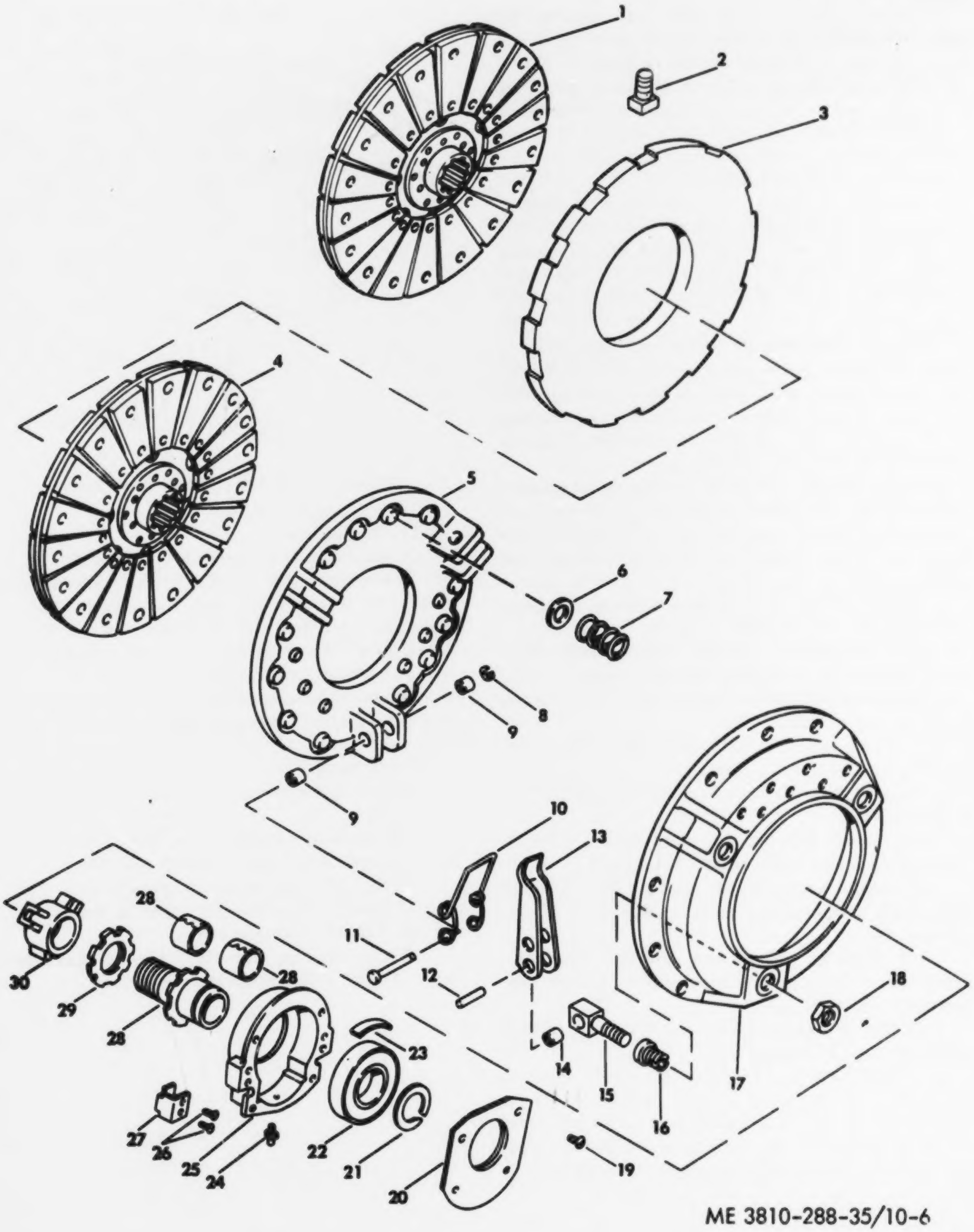
(2) Remove retaining ring (21), then press sleeve and bushing assembly (28) from bearing (22). Remove bearing housing (25) from sleeve and bushing assembly.

(3) Remove screws (26) and wear pads (27).

b. Disassemble remainder of clutch assembly as necessary to replace any defective part.

KEY to fig. 14-6.

1. Disc assembly (flywheel side)
2. Drive pin (4) (located in flywheel rim)
3. Intermediate plate
4. Disc assembly (pressure plate side)
5. Pressure plate
6. Insulating washer (18)
7. Spring (18)
8. Retaining ring (3)
9. Needle bearing (6)
10. Spring (3)
11. Pin (3)
12. Pin (3)
13. Release lever (3)
14. Needle bearing (3)
15. Eyebolt (3)
16. Adjusting nut (3)
17. Flywheel ring cover
18. Locknut (3)
19. Screw (4)
20. Cover
21. Retaining ring
22. Bearing
23. Retaining spring
24. Lubrication fitting
25. Housing
26. Screw (4)
27. Wear pads (2)
28. Sleeve and bushing assembly
29. Locknut
30. Release lever spider


1
2
3
4
5
6
7
8
9
9
10
13
11
12
28
28
30
29
28
23
14
15
16
17
18
27
26
25
24
22
21
20
19

ME 3810-288-35/10-6

Figure 14-6. Clutch assembly, exploded view.

14-15. Cleaning, Inspection, and Repair

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect pressure plate for heat discoloring, warped condition, or excessive wear at the driving slots. Replace a defective pressure plate.

c. If needle bearings must be replaced, press on end of bearing on which part number is stamped.

d. Inspect disc assemblies for excessive wear, distortion, cracks or breaks, and hub spline wear. Replace defective disc assembly.

e. Inspect flywheel ring cover for cracks, distortion, and driving lug wear. There should not be less than 0.004 inches or over 0.010 inches movement between driving lug contact surface and pressure plate slots. Replace a defective flywheel ring cover.

f. Inspect intermediate plate for worn driving slots and cracks in friction surfaces. There should not be less than 0.006 inches or over 0.014 inches movement between intermediate plate slot contact surfaces and the drive pins in flywheel rim. Replace defective intermediate plate.

g. Inspect all parts for wear or other damage, and replace defective parts.

14-16. Reassembly

Refer to figure 14-6 and assemble clutch as follows:

a. Assemble release sleeve and bearing assembly (19 through 29) as follows:

(1) Assemble wear pads (27), if removed, to bearing housing (25) with screws (26).

(2) Install bearing housing (25) over sleeve and bushing assembly (28).

(3) Press release bearing (22) onto sleeve and bushing assembly (28). Install retaining ring (21) and locknut (29). Be sure bearing is tight against retaining ring.

(4) Install bearing retaining spring (23) in housing opposite lubrication fitting (24).

(5) Hand pack release bearing and housing with high temperature lubricant specified in the current LO.

(6) Release sleeve and bearing assembly. Installation is accomplished after clutch adjustment (below).

b. Refer to figure 14-6 and assemble clutch components (5 through 18).

c. Install three ⅜—16 x 2¼ inch bolts through flywheel ring cover (17) into tapped holes in pressure plate (5). See figure 14-7. This will hold pressure springs (7, fig. 14-6) in a compressed state to facilitate clutch installation to the flywheel.

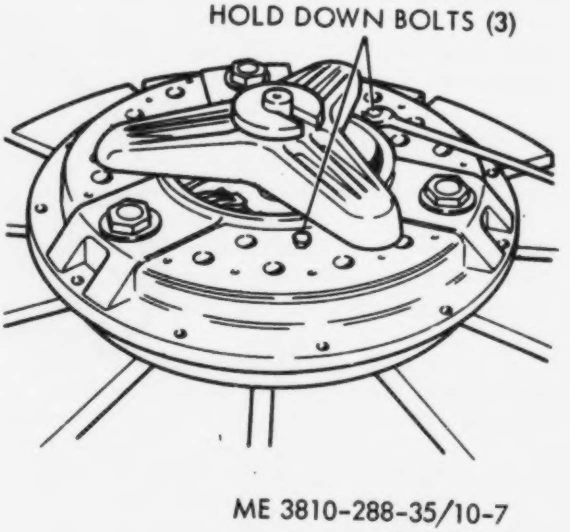


Figure 14-7. Location of hold down bolts.

14-17. Installation

a. Slide clutch cover assembly (5 thru 18, fig. 14-6); disc assemblies (1 and 4), and intermediate plate (3) over a shaft with an outside diameter somewhat less than the inside diameter of the disc assemblies. This shaft will function as an alinement tool for clutch installation.

b. Position alinement shaft through pilot bearing and install clutch components (1 through 18) to engine flywheel. Alternately torque clutch mounting hardware to 35—40 foot-pounds.

c. Remove the three hold down bolts shown in figure 10-7.

d. Remove alinement shaft from pilot bearing.

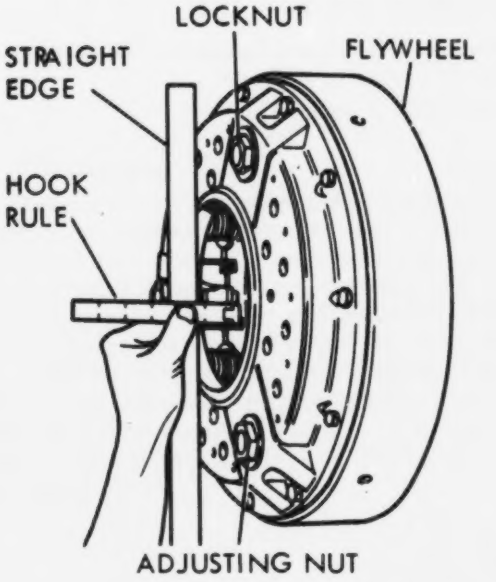
e. Adjust the clutch (step *f.* below).

f. Install the transmission (para 7-10).

g. Adjust release bearing (step *g.* below).

14-18. Clutch Adjustment

a. Turn adjusting nut (fig. 14-8) so that release lever height is approximately one inch.



ME 3810-288-35/10-8

Figure 14-8. Release lever height adjustment.

b. Turn locknut just tight enough to prevent motion, then turn locknut and adjusting nut as a unit until 1 9/32 inch release lever height is reached.

c. Hold adjusting nut so that it will not turn, and torque locknut to 60 foot-pounds.

d. Install release lever spider (30, fig. 14-6) and spider cotter pins.

e. Install release sleeve and bearing assembly (19 through 29) into spider (30). Thread sleeve assembly (28) well into spider, but do not tighten locknut (29).

14-19. Release Bearing Adjustment

a. Adjust release sleeve (28, fig. 14-6) to ⅜ inch clearance between contact surface of release bearing housing (25) and the front clutch brake disc (not shown).

b. Adjust clutch pedal linkage (refer to TM 5-3810-294-20).

Note. Do not lock the sleeve locknut (29, fig. 14-6) until the pedal linkage is connected and adjusted for free travel.

c. Press down on the clutch pedal. The release bearing housing should contact the clutch brake disc just before the clutch pedal reaches the floor board. Depress the clutch several times and recheck the clearance specified in step a. above.

d. Hold the clutch pedal down while locknut (29) is secured against release spider (30).

Caution: **Always disengage the clutch while the clutch release bearing locknut is being locked or unlocked, but engage the clutch while adjusting release sleeve clearance.**

CHAPTER 15

REPAIR OF POWER TRANSFER COMPONENTS

Section I. REPAIR OF PROPELLER SHAFTS

15-1. Description

a. There are four propeller shafts used on the carrier: the interaxle propeller shaft, located between the rear axles; the intermediate propeller shaft, located between the transfer case and the forward-rear axle; the front axle propeller shaft, located between the front axle and the lower end yoke of the transfer case; and the front propeller shaft, located between the transmission and the transfer case. The shafts are similar in construction, except for length and termination (flange or lock strap mounting).

b. Because of their similarity, the repair of the shafts is discussed collectively below. Adequate definition is presented in the accompanying illustration.

15-2. Removal

Refer to TM 5-3810-294-20 and remove propeller shaft(s).

15-3. Disassembly

Refer to figure 15-1 and disassemble propeller shaft(s) to the extent necessary for repair.

KEY to fig. 15-1.
1. Capscrew (8)
2. Lock strap (4)
3. Bearing (4)
4. Spider assembly
5. Yoke stub
6. Dust cap
7. Washer
8. Non-metallic washer
9. Lubrication fitting
10. Yoke sleeve
11. Lubrication fitting
12. Intermediate propeller shaft
13. Speedometer cable
14. Capscrew (4)
15. Lockwasher (8)
16. Nut (4)
17. Bracket
18. Capscrew (4)
19. Bracket
20. Clamp
21. Support
22. Adaptor
23. Bolt (16)
24. Companion flange (2)
25. Front axle propeller shaft
26. Front propeller shaft
27. Interaxle propeller shaft

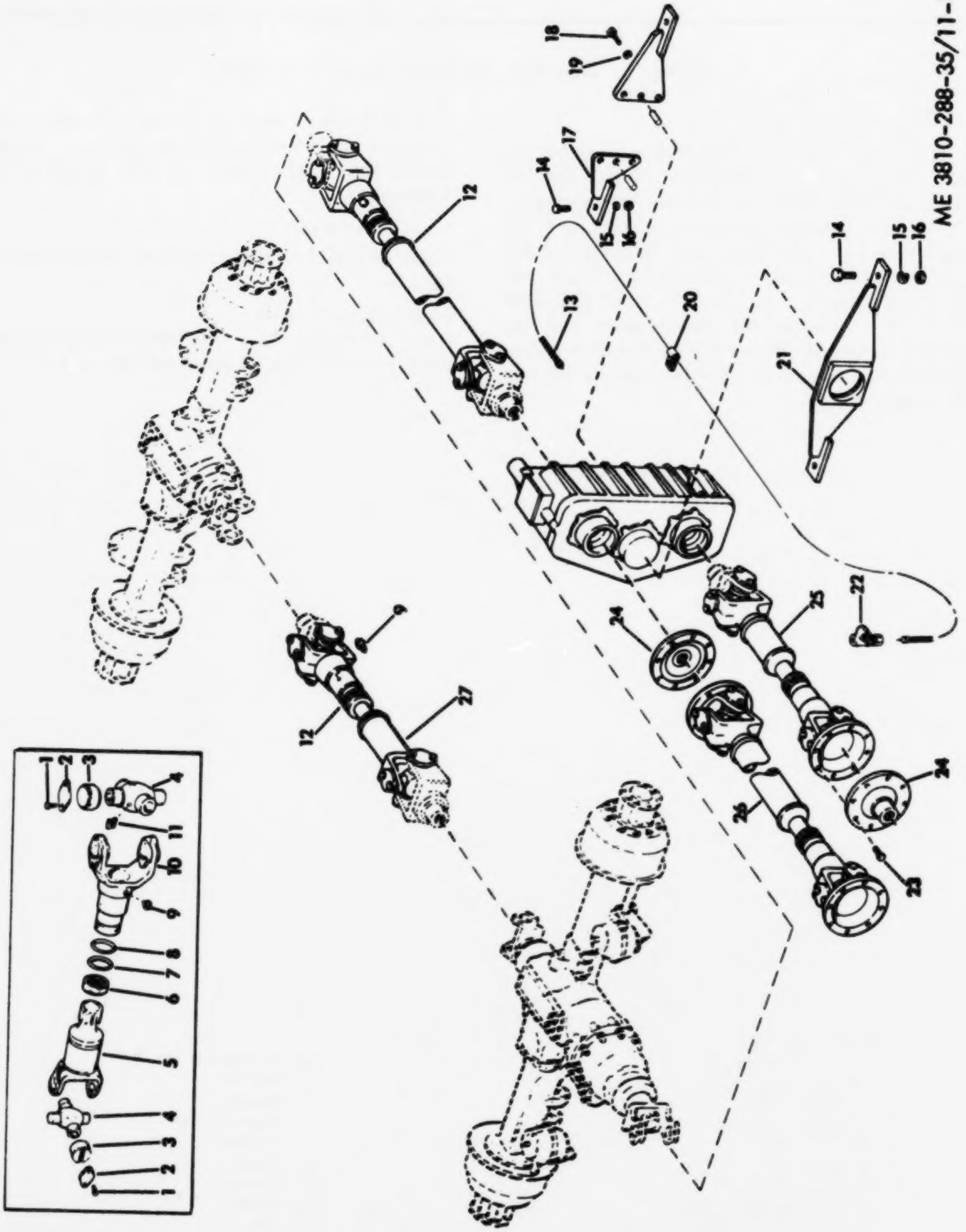

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
ME 3810-288-35/11-1

Figure 15-1. Propeller shafts, exploded view.

15-4. Cleaning, Inspection, and Repair

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect all parts for serviceability. Replace all defective parts.

c. Remove any burrs or rough spots from spider, splines, and yokes using a hand stone.

15-5. Reassembly

Refer to figure 15-1 and reassemble propeller shaft(s).

15-6. Installation

Install propeller shaft(s) and lubricate in accordance with the current LO.

Section II. REPAIR OF TRANSFER CASE

15-7. Description

The transfer case is a gear box located between the transmission and the forward rear axle. It transfers power from the transmission to the front driving axle and the rear driving axles. The transfer case also provides an extra gear reduction in the carrier power train.

15-8. Removal

Refer to paragraph 11-10 and remove the transfer case.

15-9. Disassembly

Refer to figure 15-2 and disassemble transfer case as follows:

KEY to fig. 15-2.

1. Cotter pin
2. Nut
3. Input flange
4. Yoke deflector
5. Capscrew (15)
6. Lockwasher (33)
7. Seal (3)
8. Bearing cage
9. Gasket
10. Shaft
11. Seal
12. Lockwasher (4)
13. Capscrew (4)
14. Breather assembly
15. Shift cover
16. Gasket (2)
17. Plate
18. Shift fork
19. Capscrew
20. Spring
21. Detent ball
22. Detent plunger
23. Nut
24. Bolt
25. Bearing cup
26. Bearing
27. Input shaft
28. Gear
29. Bearing (2)
30. Spacer
31. Gear
32. Spacer
33. Bearing
34. Bearing cup
35. Shim
36. Bearing cage
37. Nut (6)
38. Lockwasher (6)
39. Stud (6)
40. Capscrew (6)
41. Lockwasher (6)
42. Bearing cage
43. Shim
44. Lockwire
45. Capscrew (2)
46. Nut (20)
47. Retainer
48. Lockwasher (22)
49. Capscrew (2)
50. Cover
51. Gasket
52. Bearing cup
53. Bearing
54. Gear
55. Spacer
56. Intermediate shaft
57. Key
58. Gear
59. Bearing
60. Bearing cup
61. Housing
62. Dowel (4)
63. Plug
64. Stud (16)
65. Snap ring
66. Speedometer gear
67. Snap ring
68. Gasket
69. Lockwasher (60)
70. Capscrew (6)
71. Bearing cap
72. Bushing
73. Speedometer gear
74. Bushing
75. Cotter pin
76. Nut
77. Yoke
78. Yoke deflector
79. Seal
80. Bearing
81. Nut (6)
82. Lockwasher (6)
83. Bearing cup
84. Bearing cage
85. Spacer
86. Shaft
87. Bearing cup
88. Seal
89. Bearing
90. Gasket
91. Stud (6)
92. Housing
93. Detent ball
94. Spring
95. Capscrew
96. Washer
97. Plug
98. Nut (6)
99. Lockwasher (6)
100. Gasket
101. Drive shaft
102. Sliding clutch
103. Setscrew
104. Shift fork
105. Driving clutch
106. Stud (6)
107. Lockwasher (6)
108. Nut (6)
109. Yoke
110. Cotter pin
111. Nut
112. Yoke deflector
113. Seal
114. Bearing cage
115. Shim
116. Bearing cup
117. Bearing
118. Gear
119. Shaft
120. Bushing
121. Bearing
122. Bearing cup
123. Setscrew

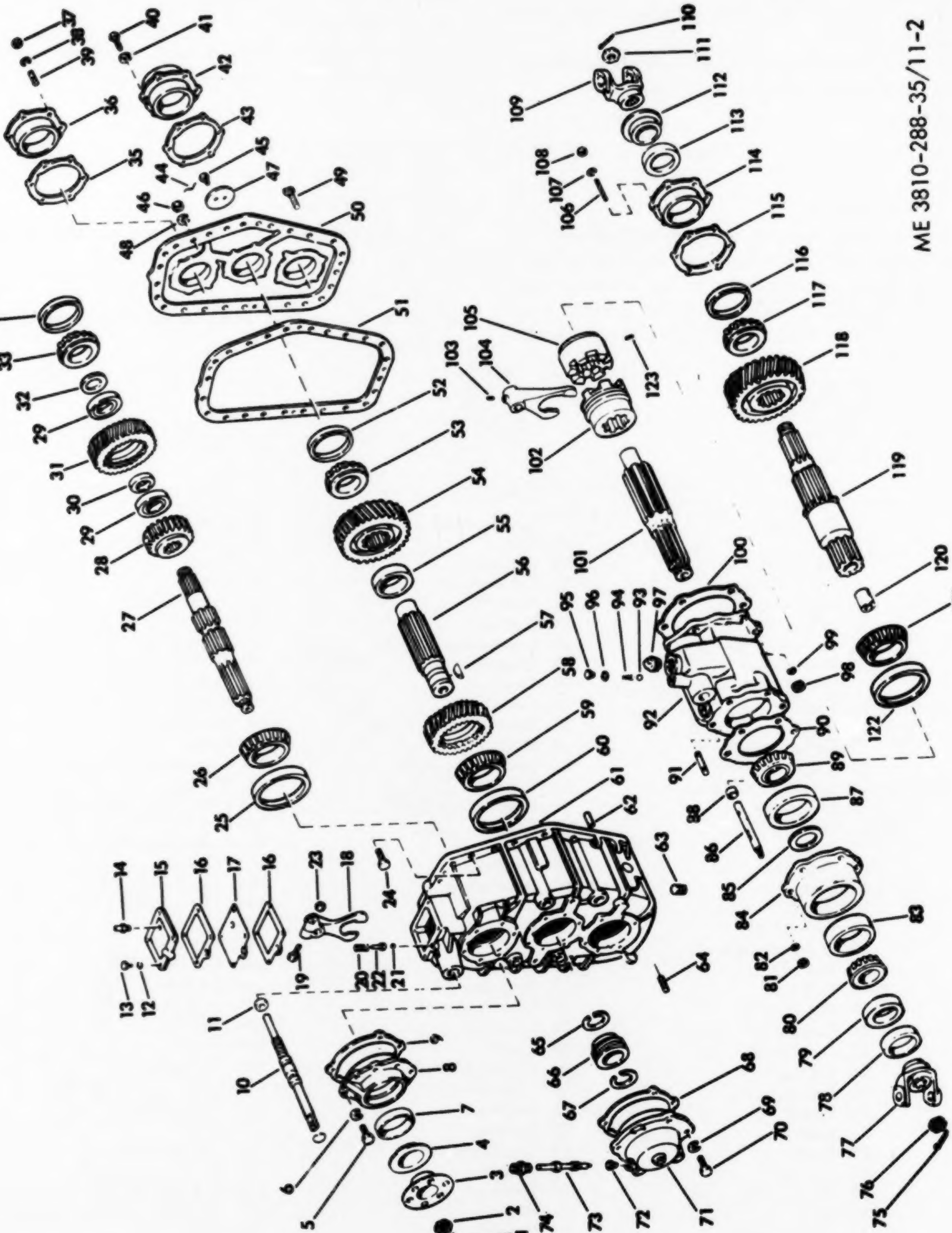

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
ME 3810-288-35/11-2

Figure 15-2. Transfer case, exploded view.

a. Remove drain plug (63) and drain the lubricant into a suitable container.

b. Remove breather (14) from cover plate (15). Remove cover plate (15) by removing capscrews (13), and lockwashers (12). Remove gaskets (16), plate (17), spring (20), plunger (22), and detent ball (21).

c. Loosen nut (23) and unscrew shaft (10) from shift fork (18) with a suitable tool. Remove the shift fork.

d. Remove companion flange (3) by removing cotter pin (1) and nut (2). Remove yokes (77 and 109) by removing cotter pins (75 and 110) and nuts (76 and 111). Do not remove yoke deflectors unless replacement is necessary.

e. Remove nuts (98) and washers (99), and remove declutch housing (92) from housing (61). Remove gasket (100).

f. Remove plug (97). Move declutching shaft (86) to the disengaged position, and remove setscrew (103). Remove shaft (86) and seal (88).

g. Remove nuts (81) and lockwashers (82). Remove bearing cage (84). Press bearings (80 and 89), bearing cups (83 and 87) spacer (85), and oil seal (79) out of bearing cage (84).

h. Remove shaft (101) from declutch housing (92). Then remove sliding clutch (102) and shift fork (104) from the declutch housing.

i. Drive dowels (62) out with a suitable punch. Remove nuts (46) and lockwashers (48), and remove cover (50) and gasket (51).

j. Remove capscrews (40) and lockwashers (41). Remove bearing cap (42) and shim (43). Remove bearing cup (52) from the bearing cap with a suitable puller.

k. Remove nuts (37 and 108) and lockwashers (38 and 107). Remove bearing cages (36 and 114) and shims (35 and 115). Press bearing cup (116) and oil seal (113) out of bearing cage (114). Remove bearing cup (34) with a suitable puller.

l. Remove main shaft assembly (26—33) from housing (61). Disassemble the main shaft as follows.

(1) Remove bearing cones (26 and 33) from input shaft (27) with a suitable puller.

(2) Remove spacer (32).

(3) Remove gears (28 and 31) from input shaft (27).

(4) Remove bearings (29) from gear (31) with a suitable puller, and then remove spacer (30).

m. Remove bushing (74) and speedometer drive gear (73) from bearing cap (71). Remove intermediate shaft assembly (53—59) from housing (61) and disassemble the shaft as follows:

(1) Cut lockwire (44), and remove capscrews (45) and bearing retainer (47).

(2) Remove snap ring (67), speedometer drive gear (66), snap ring (65), and key (57).

(3) Remove bearings (59 and 53) from shaft (56) with a suitable puller.

(4) Pull gears (54 and 58) and spacer (55) from shaft (56).

n. Remove output shaft assembly (117—121) from housing (61) and disassemble the shaft as follows:

(1) Loosen setscrew (123) and remove driving clutch (105).

(2) Remove bearings (117 and 121) from shaft (119) with a suitable puller.

(3) Pull gear (118) from shaft (119) with a suitable puller.

(4) Do not remove bushing (120) unless replacement is necessary.

o. Remove bearing cup (122) from housing (61) lower bore with a suitable puller.

p. Remove capscrews (5) and lockwashers (6), and remove bearing cage (8) and gasket (9). Press bearing cup (25) and oil seal (7) out of the bearing cage.

q. Remove capscrews (70) and lockwashers (69), and remove bearing cap (71) and gasket (68). Remove bearing cup (60) from bearing cap (71) with a suitable puller.

15-10. Cleaning, Inspection, and Repair

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect all bearings, cups and cones, including those not removed from parts of the drive unit, and replace if roller or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with sleeves. Do not use drifts and hammers because they mutilate or distort component parts. Replace defective bearings and bearing cups.

c. Inspect spur gears and clutches for wear or damage. Gear which are scored, pitted, ridged or worn must be replaced.

d. If oil seals and gaskets are removed during disassembly, replace with new parts at reassembly.

e. Remove nicks, mars, and burrs from machined or ground surfaces. Threads must be clean and free to obtain accurate adjustments and correct torque. A fine mill file or India stone is suitable for this purpose. Studs must be tight prior to reassembly.

f. When assembling component parts use a press where possible.

15-11. Reassembly

Refer to figure 15-2 and assemble the transfer case as described below. Tighten nuts and capscrews indicated in the figure to the torque specified in table 1-1.

a. Press bearing (25) and oil seal (7) into bearing cage (8). Install the bearing cage assembly on housing (61) upper bore with gasket (9), and secure the cage with capscrews (5) and lockwashers (6).

b. Press bearing cup (60) into bearing cap (71). Install the bearing cap assembly with gasket (68) on housing (61), and secure it with capscrews (70) and lockwashers (69).

c. Assemble the input shaft assembly (27 — 33) as follows:

(1) Press one bearing (29) onto shaft (27). Install spacer (30) and gear (31) on shaft (27), and install the remaining bearing (29) on the shaft.

(2) Install gear (28) on shaft (27).

(3) Install spacer (32) on the end of the shaft upon which bearing (33) is installed.

(4) Press bearings (26 and 33) on shaft (27).

d. Lay housing (61) in a horizontal position with the large opening up. Block the housing in position so that it will not move.

e. Install the input shaft assembly (26 — 33) in upper bearing cup (25).

f. Reassemble the intermediate shaft as follows:

(1) Press bearing (59) onto shaft (56), and install snap ring (65).

(2) Install key (57) in shaft (56). Aline the keyway in speedometer drive gear (66) with the key in the shaft, and press the gear onto the shaft.

(3) Install gears (54 and 58) and spacer (55) on shaft (56) in the order shown in figure 11-2.

g. Install the intermediate shaft assembly (53 — 59) in the center bearing bore in housing (61). Be sure the gears on the input shaft mesh with the gears on the intermediate shaft.

h. Reassemble the output shaft as follows:

(1) Install gear (118) on shaft (119).

(2) Press bearings (117 and 121)) on shaft (119).

(3) Install bushing (120) in the pilot bore of shaft (119) if it was removed for replacement.

(4) Install driving clutch (105) on the front end of shaft (119) and tighten setscrew (123). After the setscrew is tightened, stake it in position.

(5) Do not install the output shaft assembly (117 — 121) in the housing at this time.

i. Reassemble the declutching housing as follows:

(1) Press bearing (89) onto the front of shaft (101).

(2) Press bearing cups (83 and 87) into bearing cage (84).

(3) Install the bearing cage assembly over the shaft assembly, and install spacer (85) and bearing (80).

(4) Install shift fork (104) on sliding clutch (102), and install the assembly in housing (92).

(5) Install gasket (90) on studs (91).

(6) Center the sliding clutch in the housing and install the output shaft assembly. Rotate the output shaft until the shaft splines engage the sliding clutch.

(7) Install nuts (81) and lockwashers (82).

(8) Install shaft (86) in the declutching housing. Aline the setscrew hole in the shaft with the setscrew hole in the shift fork, and install setscrew (103). Install plug (97).

(9) Install detent ball (93), spring (94), washer (96), and capscrew (95).

(10) Install seal (88) on shaft (86), and seal (79) in bearing cage (84).

j. Install bearing cup (122) in the lower bore of housing (61). Be sure the bearing cup is installed facing the rear of the transfer case.

k. Install gasket (100) over the lower bearing bore, and install the declutching assembly on housing (61). Secure the assembly with lockwashers (99) and nuts (98).

l. Install the output shaft assembly (117 — 121) in housing (61). Be sure the pilot bore in shaft (119) engages the pilot on shaft (101).

m. Press bearing cups (34, 52, and 116) into their respective bearing cages (36, 42, and 114). Install the original shims (35, 43, and 115) on their respective bearing bores.

n. Install bearing cages (36 and 114) on their bearing bores, and secure them with lockwashers (38 and 107) and nuts (37 and 108). Install bearing cage (42) on the center bearing bore, and secure it with lockwashers (41) and capscrews (40).

o. Install a new gasket (51) on housing (61). Carefully install the cover assembly on the housing. Aline the cover and housing dowel holes, and install dowels (62). Install capscrews (49), bolts (24), lockwashers (48), and nuts (46) on the cover.

p. Install seal (113) in bearing cage (114).

q. Install shift fork (18) through the opening at the top of housing (61). Be sure that the shift fork engages gear (28). Install shaft (10) through the opening at the front of the housing, and screw it into the shift fork until the outer detent on the shaft is under the detent ball opening in housing (61). Check the adjustment by engaging gear (28) with gear (31). Then push shaft (10) in as far as it will go, and look through the detent ball opening. The detent on the shaft should be approximately 1 / 16 inch past the opening. After the shift fork is properly adjusted, tighten nut (23).

r. Install seal (11) on shaft (10).

s. Install detent ball (21), plunger (22), spring (20), gaskets (16), plate (17), cover (15) in the order shown in figure 11-2. Secure the cover with lockwashers (12) and capscrews (13). Install breather (14) in the cover.

t. Install flange (3) on the input shaft, and secure it with nut (2) and cotter pin (1). Install yokes (77 and 109) and secure them with nuts (76 and 111) and cotter pins (75 and 110).

u. Install bushing (72) on speedometer drive gear (73), and carefully install the assembly in bearing cap (71). Tap the end of the speedometer drive gear lightly with a soft hammer to seat bushing (72) in the bearing cap bore. Install bushing (74) and tighten.

15-12. Installation

Refer to paragraph 11-10 and install the transfer case. After installation, fill the transfer case with the lubricant specified in the current LO.

CHAPTER 16

REPAIR OF STEERING GEAR, FRONT AXLE DIFFERENTIAL ASSEMBLY, AND FRONT AXLE ASSEMBLY

Section I. REPAIR OF STEERING GEAR

16-1. Description

Steering is accomplished through a hydraulic-powered gear assembly. A hydraulic pump, belt driven by the carrier engine, supplies hydraulic fluid under pressure to the steering gear assembly. Rotation of the steering wheel actuates a piston in the gear, offsetting the hydraulic ports and actuating the gear system. The gear shaft, or pitman arm, rotates and actuates the tie rods and steering linkage. Movement of the linkage turns the front wheels on their spindles.

16-2. Removal

a. Refer to TM 5-3810-294-20 and remove the steering wheel.

b. Refer to figure 16-1 and remove the components of the steering system from the carrier.

KEY to fig. 16-1.

1. Steering wheel
2. Capscrew (2)
3. Lockwasher
4. Nut
5. Bracket
6. Capscrew
7. Cover plate (2)
8. Column assembly
9. Lockwasher (2)
10. Nut (2)
11. Screw (4)
12. Lockwasher (4)
13. Nut (4)
14. Steering valve assembly
15. Elbow connector
16. Hose assembly
17. Capscrew (4)
18. Steering arm
19. Dust cover (2)
20. Lubrication fitting (2)
21. Drag link assembly
22. Loop clamp (3)
23. Nut (3)
24. Lockwasher (3)
25. Screw (3)
26. Hose assembly
27. Elbow connector
28. Loop clamp (2)
29. Plug (2)
30. Bearing (4)
31. Helical spring (2)
32. Spacer (2)
33. Seat (2)
34. Cotter pin (2)
35. Link housing

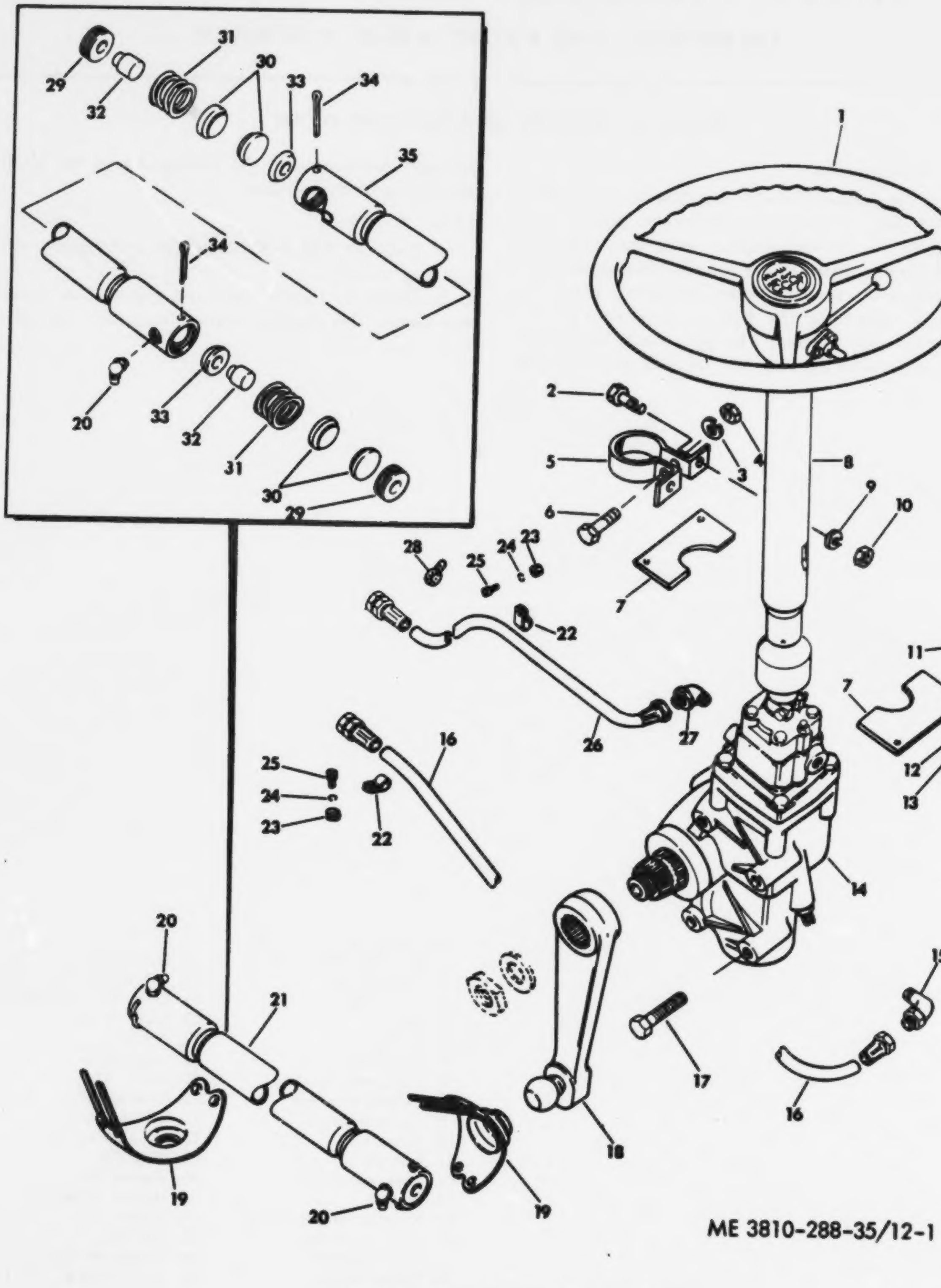

29
32
31
30
33
34
35
34
20
33
32
31
30
29
1
2
4
3
5
8
3
6
9
10
28
25
24
23
7
22
11
7
26
27
16
25
24
23
22
12
13
14
20
21
15
17
16
18
19
20
19
ME 3810-288-35/12-1

Figure 16-1. Steering assembly, exploded view.

16-3. Disassembly

a. Steering Column Disassembly. Refer to figure 16-2 and disassemble the steering column as follows:

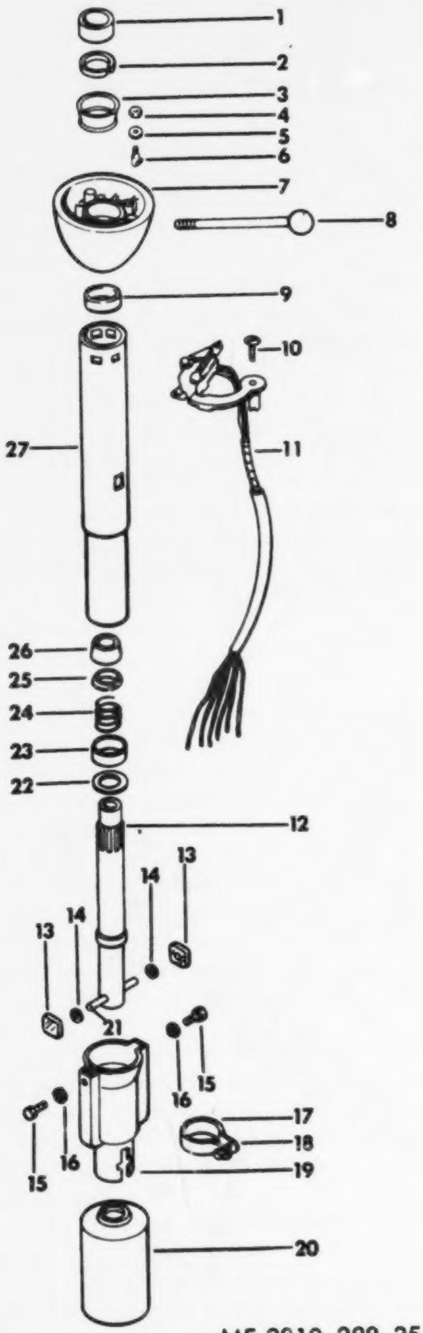


Figure 16-2. Steering column, exploded view.

KEY to fig. 16-2.
1. Spacer
2. Spring seat
3. Bearing
4. Nut (2)
5. Washer (2)
6. Bolt (2)
7. Housing
8. Switch lever
9. Ring
10. Screw (2)
11. Switch assembly
12. Tube
13. Insert (2)
14. Springwasher (2)
15. Screw (2)
16. Washer (2)
17. Clamp
18. Bolt
19. Coupling
20. Rubber shield
21. Pin
22. Washer
23. Dust cap
24. Spring
25. Spring seat
26. Bearing
27. Jacket

(1) Remove spacer (1) and spring seat (2) from tube (12), and remove tube (12) from jacket (27).

(2) Loosen bolt (18) and remove clamp (17). Slide rubber shield (20) upward.

(3) Remove screws (15), washers (16), and remove coupling (19) from tube (12). Remove inserts (13), washer springs (14), and rubber shield (20).

(4) Remove washer (22), dust cap (23), spring (24), and spring seat (25) from tube (12). Press pin (21) from tube (12) only if replacement of the pin is necessary.

(5) Remove switch lever (8).

(6) Remove screws (10) and switch assembly (11) from housing (7).

(7) Remove nuts (4), washers (5), and bolts (6) from housing (7). Remove housing (7) and ring (9) from jacket (27).

(8) Press bearings (3 and 26) from housing (7) and jacket (27) only if replacement is necessary.

b. Disassembly of Steering Gear Assembly. Refer to figure 16-3 and disassemble the steering gear as follows:

Key to fig. 16-3
1. Seal
1. Retaining ring
3. Washer
4. Seal
5. Bearing
6. Screw (4)
7. Nut
8. Upper cover
9. Adjusting screw
10. O-ring
11. Nut
12. Washer
13. Key washer
14. Thrust bearing
15. Spacer
16. Roller bearing
17. Thrust washer
18. Seal
19. Valve
20. Seal (2)
21. Seal
22. Thrust washer
23. Roller bearing
24. Spacer
25. Thrust washer
26. Screw (4)
27. Washer (4)
28. Adapter
29. Seal
30. Washer
31. Seal
32. Retaining ring
33. Worm shaft
34. Ball nut
35. Backup washer
36. Worm seal
37. Cup
38. Washer
39. Washer
40. Retaining ring
41. Piston ring
42. Setscrew
43. Seat
44. Valve
45. Rack piston
46. Seal
47. Seal
48. Housing
49. Roller bearing
50. Retaining ring
51. Seal assembly
52. Washer
53. Seal
54. Seal adapter
55. Screw (4)
56. Boot
57. Washer
58. Nut
59. Washer (6)
60. Screw (6)
61. Nut
62. Plug
63. Side cover
64. Bearing
65. Washer
66. Washer
67. O-ring
68. Adjusting screw
69. Nut
70. Seal assembly
71. Retaining ring
72. Retainer
73. Adjusting screw
74. Sector shaft

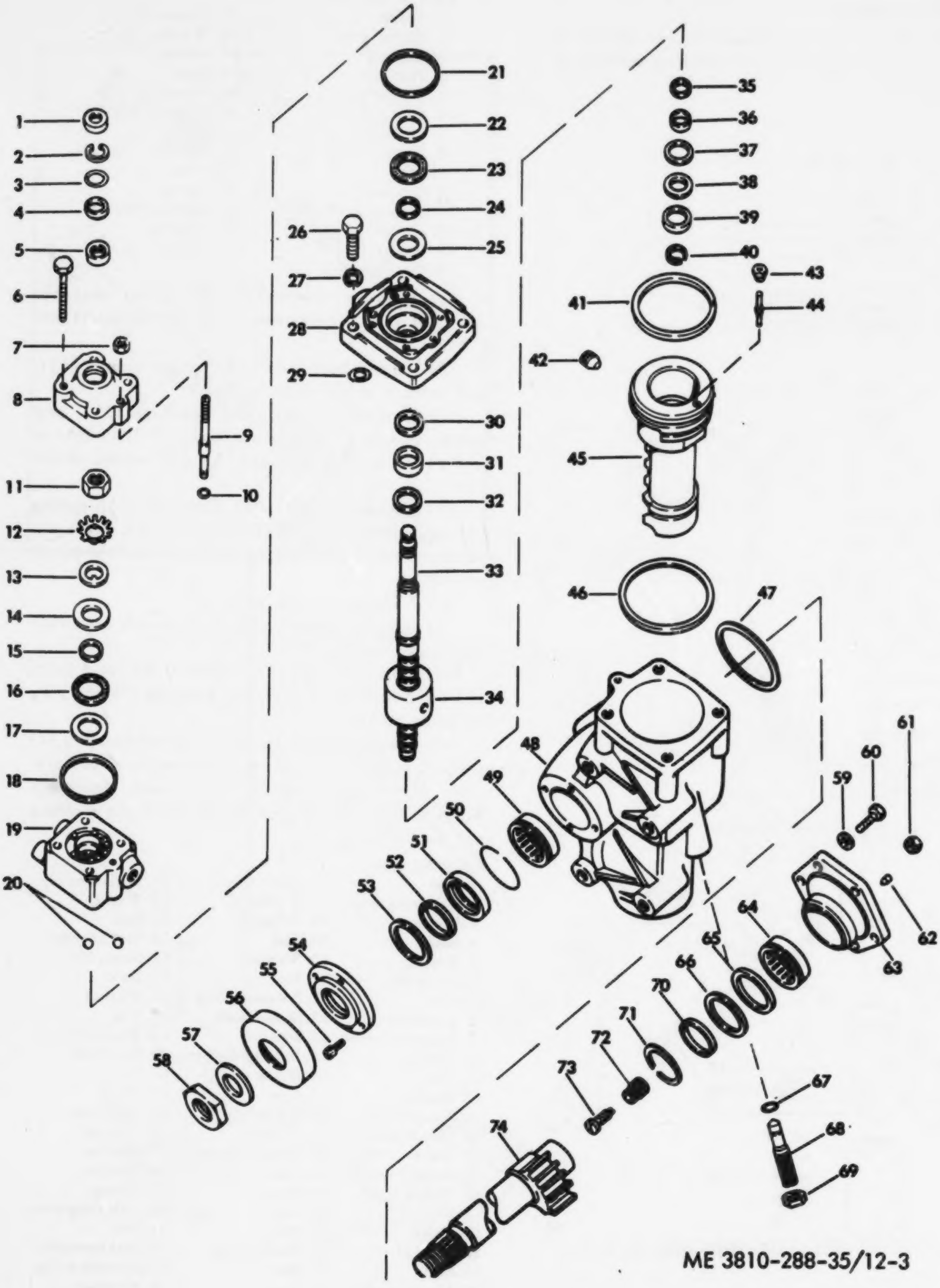

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
ME 3810-288-35/12-3

Figure 16-3. Steering gear assembly, exploded view.

(1) Remove nut (58), washer (57), and boot (56).

(2) Rotate worm shaft (33) until index mark on sector shaft (74) is perpendicular to the center line of the gear.

(3) Remove screws (60) and washers (59). Tap end of sector shaft (74) with a soft hammer to loosen and remove side cover (63), with sector gear attached, from housing. Remove seal (47).

(4) Remove screws (55) and remove seal adapter (54).

(5) Remove nut (61). Turn adjusting screw (73) clockwise to disengage sector shaft (74) from cover (63). Remove screw (73) and retainer (72).

(6) Remove plug (62) from cover. Remove retaining ring (71) and remove seal (70) and washers (66 and 65) from cover. Pull bearing (64) from cover with a suitable puller.

(7) Remove screws (26) and washers (27) from adapter (28). Rotate upper cover (8) sixty degrees and lift cover slightly. Then remove cover, valve (19), adapter (28), and balance of assembly from housing (48). Remove seal (46). Remove nut (69), adjusting screw (68) and O -ring (67).

(8) Remove setscrew (42) from piston (45). Rotate piston rack so that teeth are in a down position. Disengage rack from worm shaft (33) and ball nut (34) slowly, to expose approximately 1 inch of ball nut. Clean surface of ball nut and wrap tape around ball nut to prevent loss of steel balls. Remove piston rack from worm shaft.

(9) Remove piston ring (41), valve seat (43), and valve (44) from piston rack.

(10) Cut worm seal (36) and remove seal. Remove retaining ring (40) and remove washer (39), washer (38), cup (37), and backup washer (35) from worm shaft. Place 0.803 diameter mandrel on bottom end of worm shaft and carefully unscrew ball nut onto mandrel.

(11) Remove seal (1) and retaining ring (2). Remove screws (6) and remove upper cover (8), with nut (7), screw (9) and O-ring (10). Remove seal (18).

(12) Bend tabs of washer (12) to release nut (11), and remove the nut from the worm shaft. Remove key washer (13), thrust washers (14 and 17), bearing (16) and spacer (15) from the shaft. Remove valve (19) from the shaft. Remove seals (20 and 21).

(13) Remove thrust washers (22 and 25), bearing (23), spacer (24), and seal (29) from adapter (28). Remove worm shaft (33) from the adapter. Remove retaining ring (32), seal (31) and washer (30) from the adapter.

(14) Remove seal assembly (51), backup washer (52), and seal (51) from seal adapter (54).

(15) Remove retaining ring (50) and roller bearing (49) from housing (48).

16-4. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and dry thoroughly with compressed air. Oil all internal parts with engine oil (OE) and place on clean cloth or paper. Wrap bearings and fine machined parts in waxed paper or cheese cloth to protect surfaces.

b. Do not wipe any valve parts with cloth. Lint left from cloth may cause binding and sticking of the closely fitted parts.

16-5. Inspection and Repair

a. Refer to figure 16-3 to identify component parts.

b. If either worm shaft or ball nut are damaged replace both parts as a complete assembly.

c. Replace rack piston and / or sector shaft if teeth are damaged or worn. Replace piston if machined surfaces are damaged.

d. Check all bearings and bearing surfaces in housing and cover for wear or damage. Replace worn or damaged parts.

e. Inspect valves for wear and damage to sealing surfaces and ports. Replace valves if worn or damaged.

f. Replace thrust washers and roller bearings if worn or damaged.

g. Replace all seals, O-rings, and gaskets.

16-6. Reassembly and Installation

a. Gear Reassembly. Refer to figure 16-3 and assemble the gear assembly as follows:

(1) Place housing (48) on a wooden block to protect the side cover machined surface and carefully press bearing (49) into the housing. Bearing should extend 3 / 16 inch from housing after installation. Check bearing for free movement after installation.

(2) Coat O -ring (67) with grease (GAA) and install in the groove of adjusting screw (68). Install the adjusting screw in the bore of the housing and screw in until 7 / 8 inch of thread is exposed. Install nut (69) on adjusting screw.

(3) Clamp worm shaft (33) in a soft jawed vise with the splined end extending horizontally from the vise. Install thrust washer (25), spacer (24), roller bearing (23) and thrust washer (22) in valve (19).

Note. Item (19) is a subassembly.

(4) Install the valve assembly on worm shaft (33). Extreme care should be used when installing the valve assembly so that the reaction plungers in the valve assembly do not fall out. Install thrust washer (17), spacer (15), roller bearing (16), thrust bearing (14), key washer (13), tang washer (12) and nut (11).

(5) Carefully tighten nut (11) until there is zero bearing end play. Back the nut off ap-

proximately 20 degrees and bend the tangs of washer (12) into a matching slot in the nut. Check the valve assembly for free rotation on the shaft. The valve assembly should have no perceptible end play.

(6) Coat seals (18 and 20) with grease (GAA) and install seals in recesses of valve adapter (28).

(7) Clamp worm shaft splined end in the vise. Install adapter over worm shaft and engage pilot flange on valve in adapter. Install one screw (6) through valve and into adapter. Tighten screw finger tight only.

(8) Position ball nut (34) on worm shaft and rotate nut to engage worm groove on shaft. Install backup washer (35), new worm seal (36), new cup (37), washer (38), and washer (39) on shaft. Compress washer and seal assembly on shaft and secure with retaining ring (40). Ring must be completely seated in the groove matching recessed area of retainer washer (39).

(9) Carefully rotate the ball nut through its full travel, checking for bind to assure that all balls are in the correct recirculating path.

(10) Clamp rack piston (45) in a soft-jawed vise in a horizontal position with the teeth facing up. Expand piston ring (41) and install in groove on large end of piston.

(11) Install valve (44) and install seat (43) in threaded hole in rack piston. Tighten seat to a torque of 20 foot-pounds.

(12) Coat seal cup (37) with grease (GAA). Slide worm shaft into rack piston bore. As ball nut approaches large bore, aline hole in ball nut with hole in bore. Slide ball nut into bore until approximately one inch of ball nut is engaged. Remove tape from ball nut and slide ball nut into bore. Install new set screw (42) into rack piston to secure ball nut. Tighten set screw to a torque of 35 foot-pounds and stake set screw securely.

(13) Clamp sector shaft (74) into a vise with soft jaws by clamping the serrated end. Lubricate expanded end of adjusting screw (73) and install screw into recess in end of sector shaft. Install retainer (72) on screw and tighten to permit free rotation of adjusting screw without perceptible end play. Shake retainer into position and check screw for free movement.

(14) Press bearing (64) into bore of side cover (63). Press bearing to bottom of bore. Check rollers for freedom of movement. Work grease (GAA) into bearing and wipe off excess.

(15) Install washers (66 and 65) and seal (70) in side cover. Secure with retaining ring (71).

(16) Coat the end of sector shaft with grease (GAA) and slide shaft into cover (63) until adjusting screw (73) contacts inner cavity of side cover. Use a screwdriver and rotate adjusting screw counterclockwise until a firm stop is reached. Install plug (62) in side cover.

(17) Install bearing (5) in cover (8) by pressing bearing into bore. Press bearing into bore until face of bearing is 1⅛ inch from face of valve cover. Check bearing for freedom of rotation.

(18) Install seal (4) with seal lip towards bearing. Install washer (3) after coating washer with grease (GAA). Install retaining ring (2) in groove of upper cover. Install dust seal (1).

(19) Coat O-ring (10) with grease (GAA) and install O -ring (10) on adjusting screw (9). Install adjusting screw in cover until 13 / 16 inch is exposed beyond boss.

(20) Lubricate seals (46 and 29) with grease (GAA) and install in grooves in adapter (28). Install rack piston (45) into housing (48) and position teeth so they are visible through side cover opening. Compress piston ring to install piston in bore of housing.

(21) Install adapter (28) on housing. Aline oil transfer holes in adapter with holes in housing.

(22) Remove screw (6) from valve and adapter. Install screws (26) and washers (27) to secure adapter. Tighten screws to a torque of 70 foot-pounds.

(23) Coat worm shaft with hydraulic oil and install cover (8) on valve with adjusting screw (9) passing through valve and engaging adapter (28).

(24) Install screws (6) and tighten to a torque of 25 — 30 foot-pounds.

(25) Install nut (7) and hold screw until nut is tight.

(26) Coat seal (47) with grease and install in side cover (63). Check through side cover opening and install sector shaft (74) in housing. Aline marked center tooth space on rack piston with center tooth of sector shaft and install side cover and sector shaft. Secure side cover with screws (60) and washers (59). Tighten screws to a torque of 45-50 foot-pounds.

(27) Adjust screw (73) in side cover to provide 20 to 25 inch pounds of torque at the input shaft as the input shaft is moved 90 degrees each side of center. Back out adjusting screw one turn and note the torque required to move input shaft 90 degrees each side of center position. Move adjusting screw in to provide a rise in torque of 2-4 inch pounds at a point 45 degrees each side of center. Install nut (61) and tighten to a torque of 20 to 25 foot-pounds.

(28) Install retaining ring (50) in bearing (49) groove. Install seal (53) on retaining ring (50). Install backup washer (52) and seal assembly (51) in seal adapter (54).

Note. Be sure seal assembly is installed with the words "oil side" visible.

(29) Install seal adapter (54) and secure with screws (55). Tighten screws to a torque of 20-25 foot-pounds. Rotate the input shaft through its full travel for a minimum of five cycles. No rotational lash or binding of the sector shaft is permissible.

(30) Refer to figure 16-1 and install the steering gear on the carrier.

b. Steering Column. Refer to figure 16-2 and assemble the steering column as follows:

(1) Install bearings (3 and 26) in housing (7) and jacket (27) if they were removed.

(2) Install ring (9) in jacket (27). Then install housing (7) and secure with bolts (6), washers (5), and nuts (4). Be sure the switch wiring outlet in the housing is in alinement with the exit hole in the jacket.

(3) Install switch assembly (11) and secure with screws (10). Install switch lever (8). Be sure the wiring is not pinched between the switch assembly and housing.

(4) Install pin (21) if it was removed. Install washer (22), dust cap (23) spring (24), and spring seat (25) on tube (12).

(5) Install rubber shield (20) on tube (12). Install spring washers (14) in inserts (13) and install the inserts on pin (21).

(6) Slide coupling (19) over inserts (13). Install washers (16) and screws (15) in the coupling. The bent locking tang on the washer must be installed over the top edge of the coupling. Bend one of the washer tangs over the screw head to lock the screw in position. Slide the rubber shield off the coupling.

(7) Install clamp (17) and secure with bolt (18).

(8) Slide tube (12) in the bottom end of jacket (27). Install spring seat (2) and spacer (1). Install the wheel nut finger tight enough to keep the assembly together while it is installed in the carrier.

(9) Refer to TM 5-3810-294-20 and install the steering wheel.

Section II. REPAIR OF FRONT AXLE DIFFERENTIAL ASSEMBLY

16-7. Description

The front axle differential assembly is a double-reduction unit which employs a spiral bevel pinion gear and a helical spur pinion to control drive torque to the front axle.

16-8. Removal

a. Refer to paragraph 11-11 and remove the front axle assembly from the carrier.

b. Remove cotter pins (86, fig. 16-5), nuts (87), and bolts (75). Remove the tie rod assembly.

c. Remove nuts (104), washers (103), and screws (77). Pull the entire axle assembly outward until axle shaft (66) is disengaged from differential side gears (6, fig. 16-4).

d. Remove nuts (112, fig. 16-5) and washers (111). Loosen the two top nuts and leave nuts on studs to prevent the differential assembly from falling.

e. Tap differential housing with a leather mallet to break housing loose.

f. Place a jack or support under the differential to prevent it from falling. Remove the top nuts and washers. Remove the differential assembly. Using a small pinch bar, aline the differential housing as necessary to ease removal.

g. Place the differential assembly ir a suitable holding fixture to secure it during disassembly.

16-9. Disassembly

a. Refer to figure 16-4 and disassemble the differential assembly as follows:

KEY to fig. 16-4.

1. Bolt (8)
2. Bearing (2)
3. Differential case
4. Gear
5. Washer (2)
6. Gear (2)
7. Washer (4)
8. Gear (4)
9. Spider
10. Nut (8)
11. Cotter pin
12. Bearing cup
13. Bearing cone
14. Pinion
15. Key
16. Bevel gear set
17. Lock wire
18. Nut (6)
19. Washer (6)
20. Retaining ring (2)
21. Screw (4)
22. Plug
23. Gasket
24. Stud (6)
25. Washer (6)
26. Nut (6)
27. Bearing retainer
28. Shim
29. Shim
30. Shim
31. Gasket
32. Stud (6)
33. Gasket
34. Shim
35. Shim
36. Shim
37. Bearing cone
38. Bearing cup
39. Spacer
40. Plug
41. Bearing retainer
42. Bearing cup
43. Bearing cone
44. Oil seal
45. Gasket
46. Cover
47. Washer (6)
48. Screw (6)
49. Nut (6)
50. Washer (6)
51. Cotter pin
52. Nut
53. Washer
54. Yoke
55. Bearing washer
56. Carrier housing
57. Stud (6)
58. Gasket
59. Shim
60. Shim
61. Shim
62. Bearing retainer

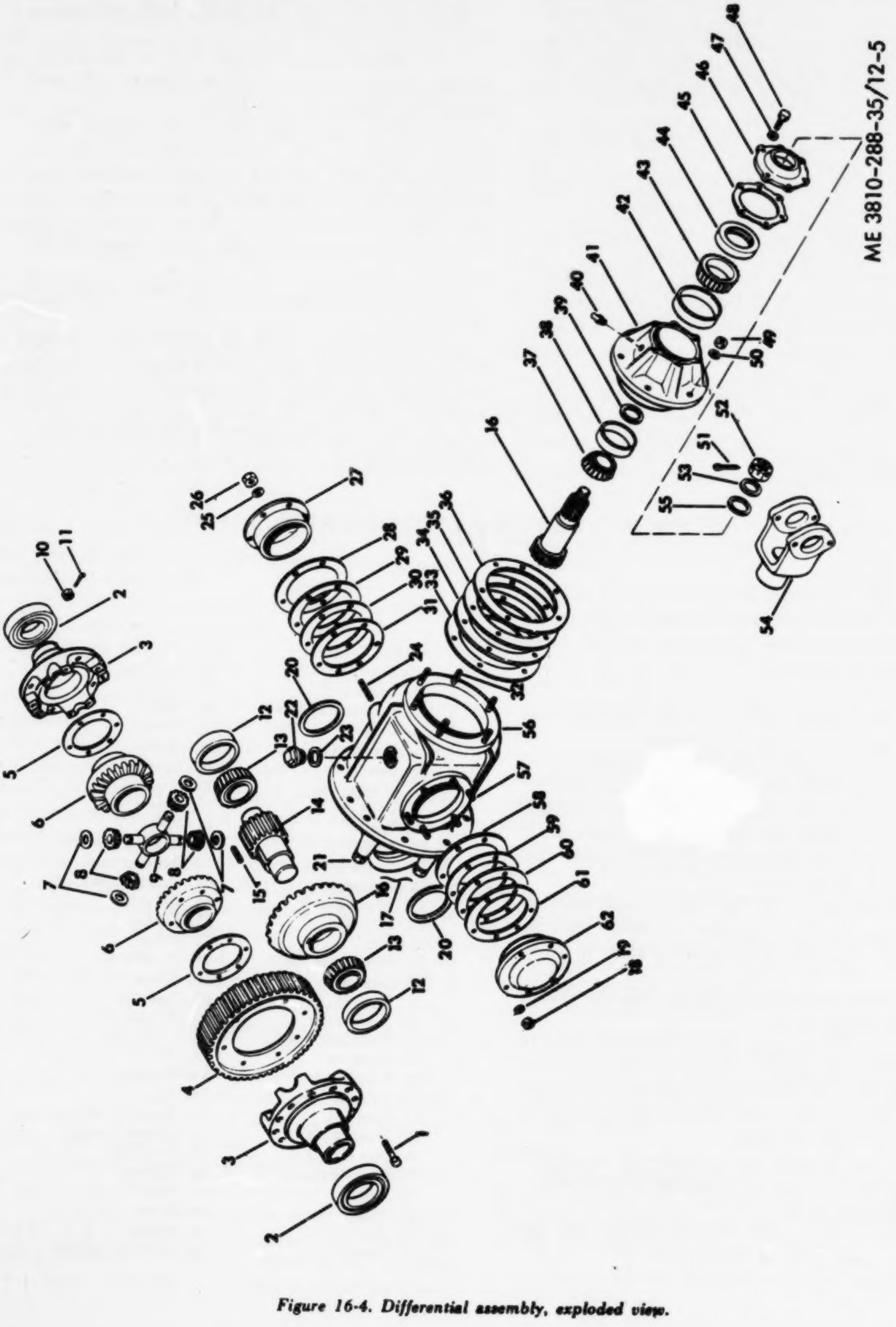

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
ME 3810-288-35/12-5

Figure 16-4. Differential assembly, exploded view.

b. Remove lock wire (17) and screws (21). Mark the differential carrier bearing caps to assure correct reassembly. Remove the bearing caps and retaining rings (20).

c. Lift the differential and gear assembly from the carrier housing.

d. Remove cotter pins (11), bolts (1), and nuts (10). Separate case halves (3), and remove gear (4). Mark the case halves before separating to assure correct reassembly.

e. Remove gears (6) and washers (5). Remove spider (9), gears (8), and washers (7). Remove bearings (2) using a suitable puller.

f. Remove nuts (49) and lockwashers (50). Lift bearing retainer (41) and attached parts from carrier housing. If retainer is not free, use a brass drift to tap gear (16) on inner face of pinion or use puller screws on retainer to remove it.

g. Remove gasket (33) and wire shim pack (34, 35, and 36) together to aid in adjustment and reassembly.

h. Remove cotter pin (51), and remove nut (52) and washer (53). Press bevel pinion gear (16) out of yoke (54) and retainer (41). Remove bearing (37) from bevel pinion gear (16) with a suitable puller.

i. Remove screws (48) and washers (47), and remove cover (46) and gasket (45). Remove spacer (39) and washer (55) from retainer (41). Press oil seal (44), bearing (43), and bearing cups (38 and 42) from retainer (41).

j. Remove nuts (18 and 26) and washers (19 and 25), and remove bearing retainers (27 and 62). Use puller screws to remove the bearing retainers.

k. Remove gaskets (31 and 58) and wire shim packs (28, 29, and 30, and 59, 60, and 61) together to aid in adjustment and reassembly. Remove bearing cups (12) from bearing retainers.

l. Remove cross shaft gear assembly from housing. Press bearings (13) and gear (16) from pinion (14). Remove key (15) from pinion.

16-10. Cleaning

a. Clean all metal parts in dry cleaning solvent (Federal Specification P-S-661) and blow dry with compressed air.

b. Clean bearings but do not blow dry with air.

c. Protect all bearings and machined surfaces after cleaning by coating with a light coat of engine oil (OE).

16-11. Inspection and Repair

a. Inspect all bearings, cones, and cup, and replace if worn, pitted or damaged.

b. Inspect gears for wear or damage. Gears which are worn, ridged, pitted or scored must be replaced. Replace gears (16, fig. 16-4) as a set.

c. Inspect differential case halves for worn, ridged, pitted, or scored surfaces. Inspect spiders, gears and thrust washers in the same manner. Replace unserviceable parts. Replace washers as complete sets.

d. Inspect differential gear (4) for wear and damage to teeth. Replace worn or damaged gears.

e. Replace pinion if teeth are worn or damaged, or if bearing surfaces are damaged.

f. Replace all oil seals and gaskets.

16-12. Reassembly

Refer to figure 16-4 and reassemble differential assembly as follows:

a. Install key (15) in shaft of pinion (14). Press shaft into bevel gear (16) until gear is set firmly against shaft shoulder. Heat bevel gear in oil heater to 200 to 250° F before installation.

b. Press bearing cones (13) on shaft of pinion (14).

c. Lubricate bearing cones with light oil. Press cups (12) into bearing retainers (27 and 62). Install bearing retainer (62), with gasket (58) and shim pack (59, 60, and 61) on housing and secure with nuts (18) and washers (19). Tighten nuts to a torque of 116-149 foot-pounds.

d. Install cross shaft assembly in housing and position bearing in bearing cap in retainer (62). Install bearing retainer (27), with gasket (31) and shim pack (28, 29, and 30), on housing and secure with nuts (26) and washers (25). Tighten nuts to a torque of 116-149 foot-pounds.

e. Rotate cross shaft assembly a few times to see that it is free in housing. Wrap a soft wire around pinion and attach a scale to wire. Check bearing preload on scale. Preload should be 5 - 15 pounds. To adjust preload, add or remove shims under bearing retainer (27).

f. Press bearing cone (37) on shaft of bevel gear (16). Press bearing caps (38 and 42) into bore of bearing retainer (41). Lubricate bearing and cups with light oil.

g. Install bevel gear (16) in bearing retainer (41). Install spacer (39) on shaft and press bearing (43) on shaft against spacer. Rotate retainer around shaft several revolutions to assure normal bearing contact.

h. With shaft in press under pressure, check bearing preload torque. Preload should be to 5 to 15 pounds. To adjust torque, change spacer (39) as required.

i. Install oil seal (44) in retainer. Install gasket (45) and cover (46) and secure with screws (48) and washers (47). Tighten screws to a torque of 53 to 67 foot-pounds.

j. Press yoke (54) on shaft of bevel gear (16). Secure yoke with nut (52), washer (53), and washer (55). Tighten nut to a torque of 81 to 104 foot pounds.

k. Install gasket (33), shim pack (34, 35, and

36) and bearing retainer (41) on housing. Secure retainer with nuts (49) and washers (50). Tighten nuts to a torque of 53 to 67 foot-pounds.

l. Check gear backlash in bevel gear set (16). Backlash should be 0.020 to 0.026 inch. Check tooth contact between bevel gears. Adjust backlash by removing or installing shims under retainers (27 and 62).

m. Install one washer (5) and one gear (6) in one case half (3). Install spider (9) with gears (8) and washers (7), in position in case half.

n. Position gear (4) on case half and install other case half (3). Aline mating marks and draw parts together with four bolts (1) and nuts (10). Check assembly for free rotation. Install remaining bolts and nuts and tighten to a torque of 53 to 67 foot-pounds. Secure nuts with cotter pins (11).

o. Install bearings (2) on bearing surfaces of case halves.

p. Install differential assembly on carrier housing with bearings in bearing cap bores. Install retaining rings (20). Install bearing caps and secure with screws (21). Tighten the screws to a torque of 290 to 370 foot-pounds. Install lock wire (17).

q. Check end play of gear (4). End play in differential bearings should be 0.0005 inch.

16-13. Installation

a. Install new gasket on differential housing flange. Install differential carrier assembly on axle housing studs, and secure with nuts (112, fig. 16-5).

b. Push the axle assembly toward the differential and rotate the brake drum until the splines in axle shaft (66) engage side gears (6). Install screws (70), washers (103), and nuts (104). Tighten the nuts to 250 to 300 foot-pounds.

c. Install the tie rod assembly and secure with bolts (75) and nuts (87). Install cotter pin (86).

d. Refer to paragraph 11-11 and install the axle assembly on the crane carrier.

Section III. REPAIR OF FRONT AXLE ASSEMBLY

16-14. Removal

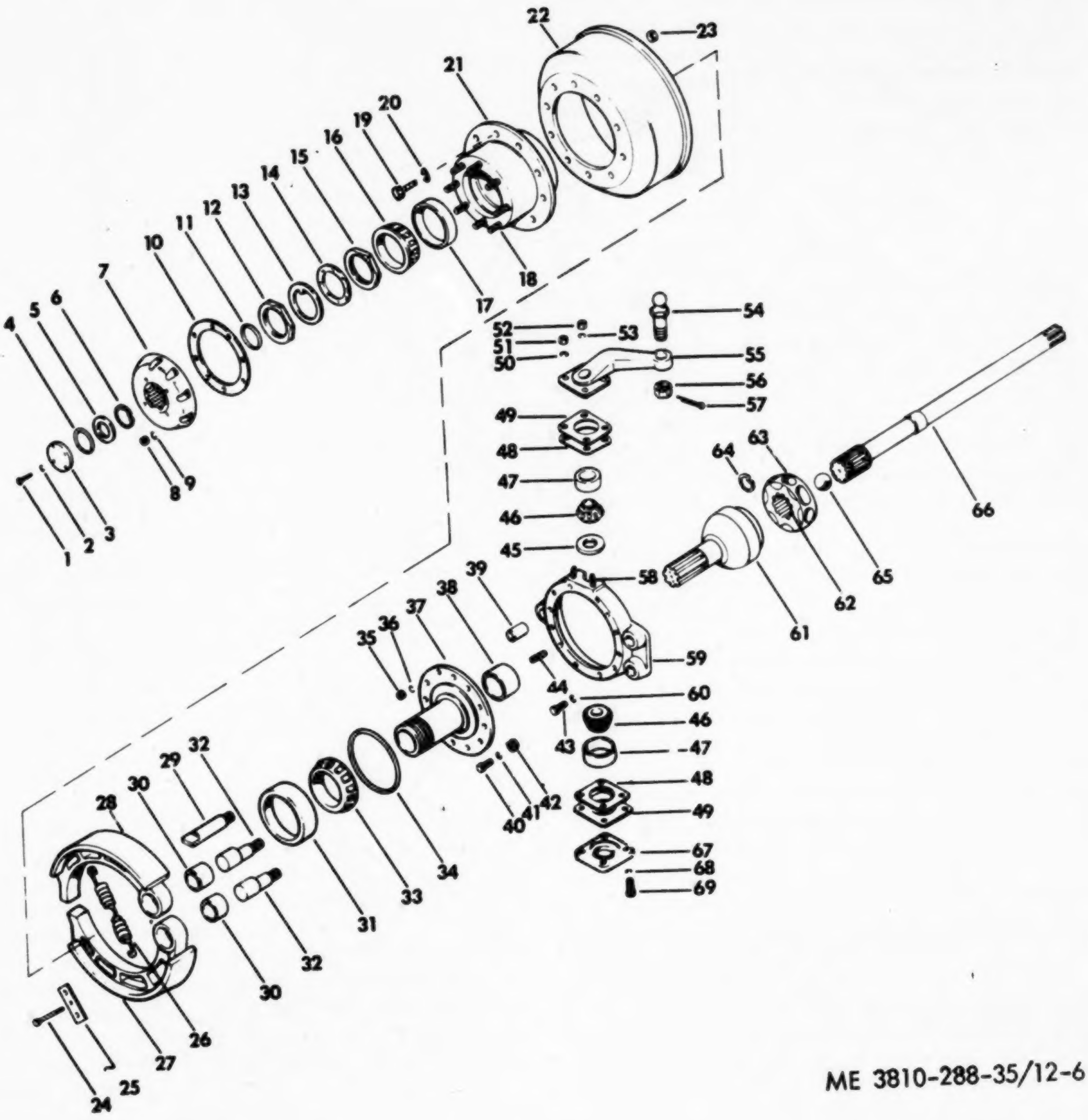
a. Refer to paragraph 11-11 and remove the front axle from the crane carrier.

b. Refer to paragraph 16-8 and remove the differential assembly from the front axle.

16-15. Disassembly

Refer to figure 16-5 and disassemble the front axle as follows:

KEY to fig. 16-5 (1)
1. Screw (4)
2. Washer (4)
3. Plate (2)
4. Packing (2)
5. Washer (2)
6. Retaining ring (2)
7. Driving flange (2)
8. Nut (16)
9. Washer (16)
10. Gasket (2)
11. Packing (2)
12. Nut (2)
13. Key washer (2)
14. Washer (2)
15. Nut (2)
16. Bearing (2)
17. Bearing cup (2)
18. Stud (16)
19. Nut (20)
20. Stud (20)
21. Wheel hub (2)
22. Brake drum (2)
23. Nut (20)
24. Bolt (2)
25. Retainer (2)
26. Spring (2)
27. Brake shoe (2)
28. Brake shoe (2)
29. Camshaft (2)
30. Bushing (4)
31. Bearing cup (2)
32. Anchor pin (4)
33. Bearing (2)
34. Oil seal (2)
35. Nut (24)
36. Washer (24)
37. Spindle (2)
38. Bushing (2)
39. Bushing
40. Bolt (24)
41. Washer (24)
42. Nut (24)
43. Screw (4)
44. Stud (24)
45. Retainer (2)
46. Bearing (4)
47. Bearing cup (4)
48. Shim
49. Shim
50. Washer (2)
51. Nut (2)
52. Nut (2)
53. Washer (2)
54. Ball stud
55. Steering arm
56. Nut
57. Cotter pin
58. Stud (2)
59. Flange (2)
60. Washer (4)
61. Ball joint (2)
62. Inner race (2)
63. Ball cage (2)
64. Retaining ring (2)
65. Ball (24)
66. Axle shaft (2)
67. Bearing cap (3)
68. Washer (12)
69. Screw (12)



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69

ME 3810-288-35/12-6 ①

Figure 16-5. Front axle assembly, exploded view. (Sheet 1 of 2).

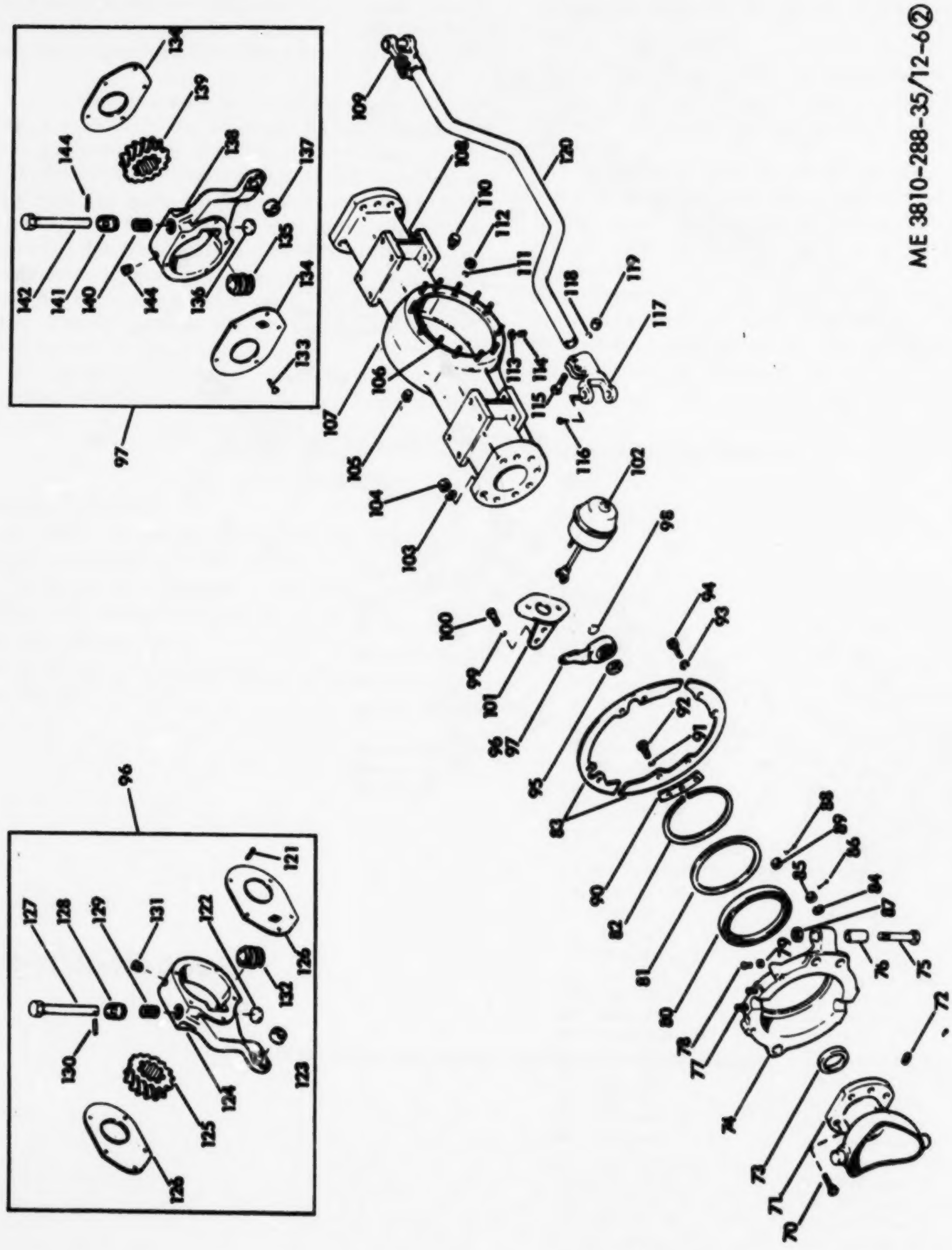

96
127
128
129
130
131
122
121
126
132
123
124
125
126
97
142
141
140
144
144
136
135
134
133
138
139
137
134
109
108
120
110
112
111
118
119
117
107
106
105
113
114
115
116
104
103
102
98
100
99
101
96
97
95
92
91
93
94
83
90
82
81
80
88
89
85
86
84
87
79
76
75
78
77
74
72
73
71
70
ME 3810-288-35/12-6②

Figure 16-5. Front axle assembly, exploded view. (Sheet 2 of 2).

70. Screw (16)
71. Trunnion socket (2)
72. Plug (2)
73. Oil seal (2)
74. Flange (2)
75. Tie rod bolt (2)
76. Bushing (2)
77. Stud (2)
78. Stop screw (2)
79. Nut (2)
80. Oil seal (2)
81. Seal retainer (2)
82. Retaining ring (2)
83. Dust shield (4)
84. Washer
85. Lock nut
86. Cotter pin (2)
87. Nut (2)
88. Cotter pin (2)
89. Nut (2)
90. Plate (8)
91. Washer (8)
92. Screw (8)
93. Washer (16)
94. Screw (16)
95. Washer (6)
96. L. H. Slack adjuster
97. R. H. Slack adjuster
98. Retaining ring (2)
99. Washer (4)
100. Screw (4)
101. Bracket (2)
102. Brake chamber (2)
103. Washer (16)
104. Nut (16)
105. Plug
106. Stud (12)
107. Gasket
108. Axle housing
109. Yoke
110. Breather
111. Washer (12)
112. Nut (12)
113. Gasket
114. Plug
115. Bolt (4)
116. Pin (2)
117. Yoke
118. Washer (4)
119. Nut (4)
120. Tie rod
121. Rivet (5)
122. Plug
123. Bearing
124. Housing
125. Gear
126. Cover (2)
127. Gear shaft
128. Lock
129. Spring
130. Pin
131. Plug
132. Worm gear
133. Rivet (5)
134. Cover (2)
135. Worm gear
136. Plug
137. Bearing
138. Housing
139. Gear
140. Spring
141. Lock
142. Gear shaft
143. Pin
144. Plug

a. Remove screws (1) and washers (2) and remove plate (3). Remove packings (4), washers (5), and retaining ring (6). Remove nuts (8) and washers (9) and remove driving flanges (7) and gaskets (10). Remove packings (11).

b. Bend tabs on washers (13), remove nuts (12 and 15) and washers (14) from spindles (37). Remove nuts (19 and 23) and remove wheel hubs (21). Remove bearing cones (16 and 33) and cups (17 and 31) with a suitable puller. Remove brake drum (22).

c. Remove brake shoe spring (26). Remove screws (24), cotter pins (88), nuts (89), and retainers (25). Remove anchor pins (32), nuts (85), washers (89) and camshaft (29). Remove brake shoes (27 and 28). Press bushings (30) from brake shoes.

d. Remove screws (100) washers (99), and brackets (101), and brake chambers (102). Remove retaining rings (98), slack adjusters (96 and 97), and washers (95).

e. Remove retaining rings (83), oil seal retainer (81) and oil seal (80) from flange (74).

f. Remove nuts (35) and washers (36) and remove spindles (37) from axle.

g. Remove the axle shaft and ball joint assembly from the axle housing. Use care when removing axle shaft to prevent damage to inner oil seal. Clamp axle shaft (66) in a copper-jawed vise with outer race ball joint (61) in a downward position.

h. Use a brass drift and drive ball joint (61), ball cage (63), and inner race (73) from axle shaft. In driving the ball joint out, it will be necessary to destroy retaining ring (64).

i. Tilt ball cage (63) in ball joint (61) until one ball (65) can be lifted out. Then tilt cage until next ball can be lifted out, and continue until all the balls are removed. Rotate the cage and inner race at right angles to ball joint with two elongated openings in cage alined with opposite teeth of ball opening. Lift cage and inner race from ball joint.

j. Turn inner race (62) at right angles to cage (63). Aline tooth on race with elongated hole in cage and roll inner race from cage.

k. Remove cotter pins (86), nuts (87) and bolt (75) and disconnect tie rods. Remove screws (92), washers (91), and plates (90), and remove dust shields (82).

l. Remove screws (70), nuts (104) and washers (103) and remove trunnion socket assemblies from axle housing.

m. Remove nuts (51 and 52) and washers (50 and 53) and remove steering arm (55). Remove cotter pin (57), nut (56) and ball stud (54) from steering arm. Remove shim pack (49 and 48) and wire them together to aid in reassembly.

n. Remove screws (69), washers (68), and bearing caps (67). Remove shim packs (49 and 48). Wire packs together to assure correct reassembly. Remove bolts (40), nuts (42), and washers (41).

o. Remove bearing cups (47), bearing (46), and retainers (45). Separate flanges (59 and 74). Remove oil seals (73) from housing.

16-16. Cleaning

a. Clean all metal parts in dry cleaning solven (Federal Specification P-S-661) and dry thoroughly with compressed air. Wipe parts dry with soft; clean; lintless absorbent paper towels or wiping rags.

b. Do not spin bearings with compressed air. Coat all bearings and machines surfaces with light oil to prevent rust and corrosion.

16-17. Inspection and Repair

a. Inspect all bearing cups and cones for wear, pitting, and damage. Replace all worn, pitted, or damaged bearings.

b. Inspect axle shafts and ball joints for torsional fractures and damaged splines. Replace unserviceable parts.

c. Inspect spindles for damage and cracks. Inspect for damaged or elongated bolt holes. Replace all damaged spindles.

d. Inspect balls, cages, and inner bearings for rough spots, cracks and damages. Replace all unserviceable balls, cages, and inner bearings.

e. Inspect all threads on parts and tapped holes for damaged or srtripped threads. Retap threads if possible. Replace unserviceable parts.

16-18. Reassembly

Refer to figure 16-5 and reassemble the front axle assembly as follows:

a. Install oil seals (73) in trunnion socket (71) using a suitable driver. Locate seals squarely against the recessed shoulder in the trunnion socket.

b. Install trunnion socket in a copper-jawed vise and drive bearing (46) on knuckle pins using a suitable driver.

c. Install flanges (59 and 74) on trunnion socket (71) and secure flanges together with bolt (40), nuts (42) and washers (41). Tighten screws to a torque of 92 to 118 foot-pounds. Install bearings cups (47) and retainers (45) in flange bores. Install bearing shim packs (48 and 49) and bearing caps (67) on flanges. Secure caps with screws (69) and washers (68). Tighten screws to a torque of 160 to 205 foot-pounds.

d. Install ball stud (59) in steering arm (55) and secure stud with nut (56) and cotter pin (57). Install steering arm on flanges with shim pack (48 and 49), secure steering arm with nuts (51 and 52) and washers (50 and 53). Tighten nuts to a torque of 160 to 205 foot-pounds.

e. Check steering flange for end play and oscillation. Add or remove shim from shim packs to reduce end play and oscillation. After end play has been reduced to zero, remove one 0.005-shim from each shim pack.

f. After correcting end play, retorque screws and nuts. After torquing a small amount of drag should be felt but there should be no binding. Install dust shields (82) and secure with screws (92), washers (91) and plates (90).

g. Mount the trunnion assembly on the axle housing and secure with screws (70), nuts (104) and washers (103). Tighten the nuts to a torque of 116 to 149 foot-pounds.

h. Install inner race (67) in cage (63) by alining race teeth with elongated hole in cage. Turn race within cage to a position parallel with cage.

i. Install ball joint (61) in a vise with copper jaws. Install assembled race and cage in ball joint and tilt into position in ball joint.

j. Tilt the cage until one ball (65) can be placed in cage. Continue to tilt cage and install balls until all balls are in place in cage.

k. Install retaining ring (64) in groove in axle shaft (66). Aline splines of axle shaft with splines of inner race in ball joint. Slide the inner race onto the shaft until it rests against the retaining ring. Compress retaining ring (64) with two screwdrivers until the inner race starts on the axle shaft. Then tap the end of the shaft with a raw-hide mallet to seat the retaining ring.

l. Hand pack ball joint with grease by forcing grease into ball joint and inner race cavities. Hand pack inner walls of trunnion socket (71).

m. Install axle shaft (66) into housing through trunnion socket. Install with care to prevent damage to oil seal.

n. Install oil seal (80), retainer (81), and retaining ring (83). Install bearing (33) on shaft of spindle. Install spindle on flange and secure with nuts (35) and washers (36). Tighten nuts to a torque of 185 to 235 foot-pounds.

o. Press bushings (30) in brake shoes. Install brake shoe assemblies (27 and 28), camshafts (29), anchor pins (32), and retainers (25). Secure retainers with bolts (24), nuts (89), and cotter pins (88). Secure anchor pins with nuts (85) and washers (84).

p. Install slack adjusters (96 and 97) and secure with retaining rings (98) and washers (95). Install brackets (101) and secure with screws (100) and washers (99). Tighten screws to a torque of 160 to 205 foot-pounds. Install brake chambers (102).

q. Install bearing cups (17 and 31) in wheel hubs (21). Install brake drums (22) and hubs (21) and secure with nuts (19 and 23). Tighten nuts to a torque of 160 to 205 foot-pounds.

r. Install bearing (16) and adjusting nuts (15). Tighten the nut while drum is being rotated until nut is tight. Rotate wheel in both directions to make sure bearings and related parts are fully seated. Back off nut ¼ turn to relieve preload on bearings. Check rotating torque with a scale and a wire. Preload torque should be 5 to 9 foot-pounds. Adjust preload with adjusting nut. Where preload is correct, install washers (13 and 14) and lock nut (12). Secure load nut with tabs on washer (13).

s. Pack bearings with grease by hand and install packings (11). Install retaining rings (6), washers (5) and packings (4) in driving flanges (7). Install flanges on hub and secure with nuts (8) and washers (9). Install plates (3) and secure with screws (1) and washers (2).

t. Install tie rod (120) on axle and secure with tie rod bolts (75) and nuts (87). Install cotter pin (86).

16-19. Installation

a. Refer to paragraph 16-13 and install the differential assembly on the axle.

b. Refer to paragraph 11-11 and install the front axle on the crane carrier.

CHAPTER 17

REPAIR OF REAR DRIVE AND SUSPENSION ASSEMBLIES

Section I. REPAIR OF REAR SUSPENSION ASSEMBLY

17-1. Description

The two rear axle assemblies are mounted on the rear suspension assembly. The rear suspension assembly basically consists of the torque rods and equalizer beams which absorb the road shock.

17-2. Torque Rod Assembly

a. Removal and Disassembly.

(1) Position hydraulic jack under the rear of the carrier frame. Raise the jack until weight of carrier is off the rear axles, but with rear wheels still on the ground.

(2) Remove cotter pins (11 and 5, fig. 17-1), nuts (6), and washers (12) from torque rod assembly (14).

(3) Remove torque rod from axle assembly and carrier frame.

(4) Disassemble torque arm assembly (1, 2, 3, 4, 8, 7, 9, 10, and 29) as necessary to replace defective part(s).

KEY to fig. 17-1.
1. Capscrew (16)
2. Lockwasher (16)
3. Cover (4)
4. Socket half (4)
5. Cotter pin (4)
6. Nut (4)
7. Shim
8. Shim (16)
9. Stud ball (4)
10. Torque rod (4)
11. Cotter pin (4)
12. Washer (4)
13. Bushing
14. Torque rod assembly (4)
15. Bracket (2)
16. Cotter pin (8)
17. Nut (8)
18. Stud (4)
19. Spring (8)
20. Retainer (8)
21. Washer (8)
22. Thrust washer (4)
23. Sleeve (2)
24. Equalizer beam assembly (2)- includes 19 thru 23 and 30 thru 37.
25. Nut (4)
26. Stud (4)
27. Clamp (2)
28. Washer (4)
29. Support assembly (2) — includes 25 thru 28
30. Nut (3)
31. Lockwasher (8)
32. Socket assembly (4)
33. Stud ball (4)
34. Lockwasher (8)
35. Capscrew (8)
36. Sleeve (4)
37. Equalizer beam (2)
38. Lubrication fitting (14)

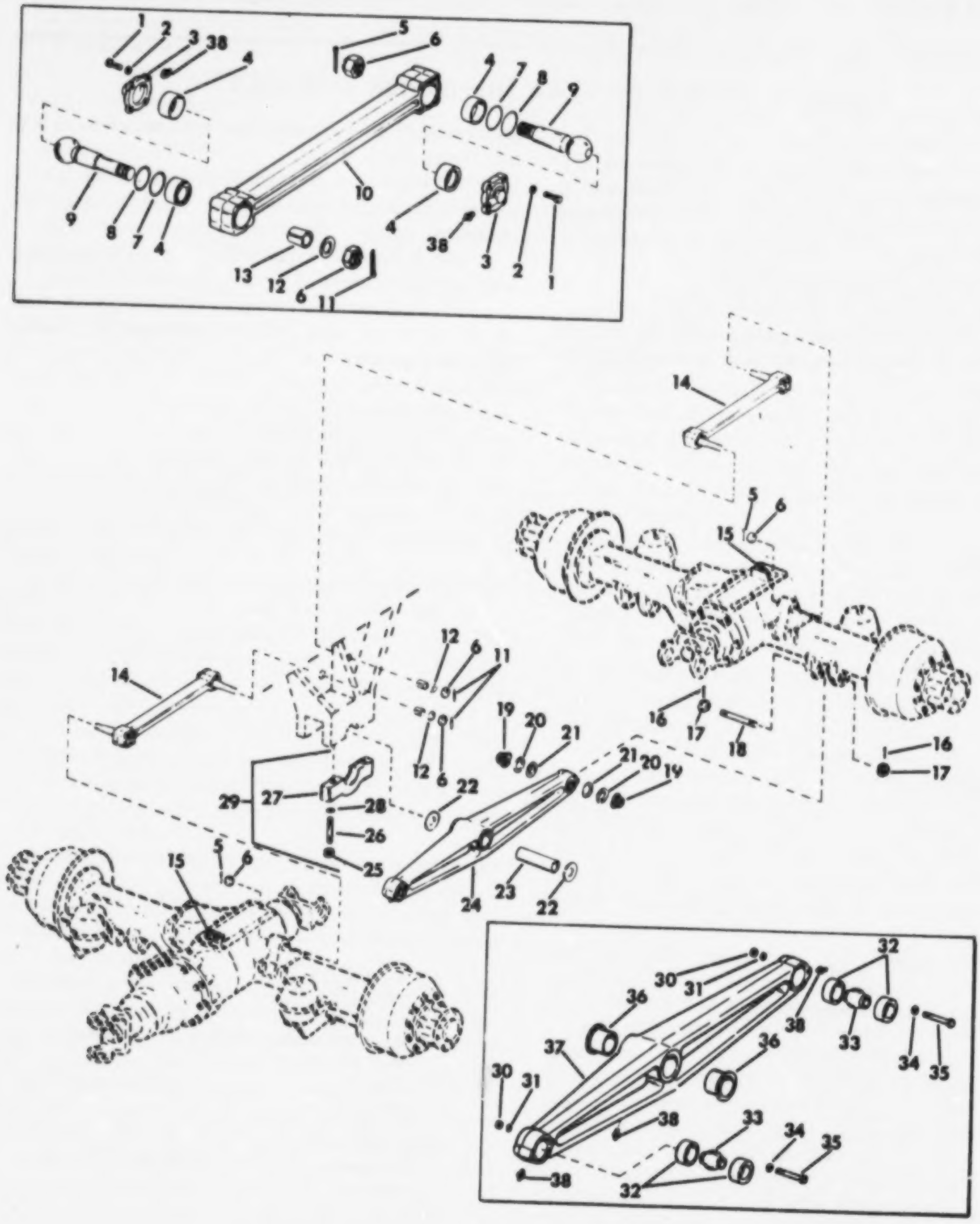

1
2
3
38
4
5
6
4
7
8
9
9
8
7
4
10
4
13
12
6
11
38
3
2
1
14
5
6
15
14
12
6
11
12
6
19
20
21
16
17
18
16
17
21
20
19
29
27
22
28
26
25
5
6
15
24
23
22
32
30
31
36
38
33
34
35
37
36
30
31
38
33
34
35
38
32
ME 3810-288-35/13-1

Figure 17-1. Rear suspension assembly, exploded view.

b. Cleaning, Inspection, and Repair.

(1) Remove dirt, grease, and any other accumulations using an approved cleaning solvent.

(2) Inspect torque rod for a bent or twisted condition. Replace damaged torque rod.

(3) Inspect all parts for excessive wear or other damage, and replace defective parts.

c. Reassembly and Installation.

(1) Assemble torque rod assembly (1 — 4, 7, 8, 9, 10, and 29, fig. 17-1).

(2) Install torque rod assembly (14) between carrier frame and axle assembly. Install washers (12), nuts (6), and cotter pins (11). Be sure nuts are securely tightened.

17-3. Equalizer Beam Assembly

a. Removal and Disassembly.

(1) Remove wheels (refer to TM 5-3810-294-20).

(2) Remove cotter pins (16, fig. 17-1), nuts (17), studs (18), spring (19), washers (21), and retainers (20) from both ends of equalizing beam assembly (24).

(3) Remove nuts (25), washers (28), and lower half of clamp (27) to release equalizer beam from frame. Remove washers (22) and sleeve (23).

(4) Disassemble equalizer beam assembly (30, 35, 31, 34, 32, 33, 36, 37) as necessary to replace defective part(s).

b. Cleaning, Inspection, and Repair.

(1) Remove dirt, grease, and other similar accumulations from parts using an approved cleaning solvent.

(2) Inspect equalizer beam for cracks, breaks, or other damage. Weld repair cracks and breaks. If damage is too extensive for weld repair, replace equalizer beam.

(3) Inspect all parts for excessive wear or other damage, and replace defective items.

c. Reassembly and Installation.

(1) Assemble equalizer beam assembly (30, 35, 31, 34, 32, 33, 36, 37, fig. 17-1).

(2) Press sleeve (23) into equalizer beam and install washers (22) onto sleeve.

(3) Install equalizer beam assembly (24) between rear axles.

(4) Install washers (21), retainers (20), and springs (19). Install studs (18), nuts (17), and cotter pins (16). Be sure nuts are tightened securely.

(5) Lubricate sleeve surface of clamp (27) with lubricant specified in current LO.

(6) Install clamp (27), washers (28), and nuts (25). Tighten nuts securely.

Section II. REPAIR OF HUB AND DRUM, INTERAXLE DIFFERENTIAL, AND REAR AXLE ASSEMBLIES

17-4. Description

a. The forward-rear axle assembly is equipped with an interaxle differential which divides drive torque between the forward-rear and rear-rear axle assemblies. The differential incorporates a lockout device which converts the rear tandem assembly to a through drive type tandem. The differential lockout is actuated by an air chamber and controlled from the carrier cab.

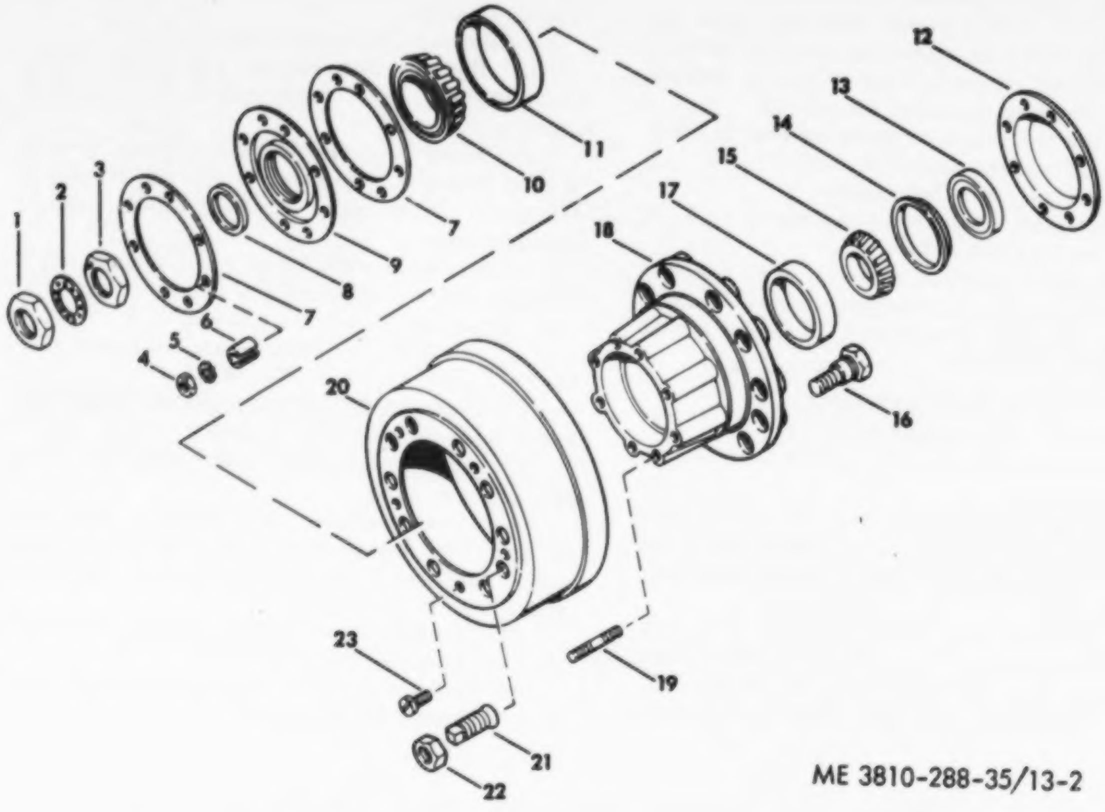
b. Both axle assemblies are similar in construction. The basic differences are noted by asterisks (*) in the legend for figure 17-3.

17-5. Hub and Drum Assembly

a. Removal and Disassembly.

(1) Remove wheels (refer to TM 5-3810-294-20).

(2) Remove nuts (4, fig. 17-2) and lockwashers (5). Pound on end of axle shaft (45, fig. 17-3) flange to loosen, then remove dowels (6, fig. 17-2) and axle shaft.



1. Nut
2. Washer
3. Nut
4. Nut (8)
5. Lockwasher (8)
6. Dowel (8)
7. Gasket (2)
8. Seal wiper
9. Seal
10. Bearing
11. Bearing cup
12. Slinger
13. Seal wiper
14. Seal
15. Bearing
16. Stud (10)
17. Bearing cup
18. Hub
19. Stud (8)
20. Drum
21. Stud (10)
22. Nut (10)
23. Screw (5)

Figure 17-2. Hub and drum assembly.

(3) Remove gaskets (7), seal wiper (8), and oil seal (9).

(4) Remove nut (1), washer (2), and nut (3). Remove bearing (10).

(5) Remove hub (18) and drum (20) as a unit. Remove bearing cups (11 and 17) from hub (18).

(6) Remove bearing (15), oil seal (14), seal wiper (13), and oil slinger (12).

b. Cleaning, Inspection, and Repair.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect bearings and bearing cups for nicks, pits, and scoring. Replace defective bearings and bearing cups.

(3) Inspect all parts for excessive wear and other damage. Replace defective parts as necessary.

(4) Replace all gaskets and oil seals.

c. Reassembly and Installation.

(1) Install seal wiper (13, fig. 17-2) and oil seal (14) in oil slinger (12).

(2) Pack bearing (15) and bearing cups (11 and 17) with grease specified in the current LO

(3) Install bearing (15) into bearing cup (17),

then install the assembly along with bearing cup (11) into hub (18).

(4) Install hub (18) and drum (20) as a unit.

(5) Pack bearing (10) with grease specified in the current LO and install in bearing cup (11).

(6) Install nut (3). Draw nut up tight, then back off one-quarter turn. Spin the hub and drum in both directions and inspect for free rotation without excessive end play. Readjust nut (3) as necessary.

(7) Install washer (2) and nut (1), and tighten nut securely.

(8) Install seal wiper (8). Place oil seal (9) and gaskets (7) over studs (19).

(9) Install axle shaft (45, fig. 17-3) and dowels (7, fig. 17-2), and secure with lockwashers (5) and nuts (4).

(10) Install wheels (refer to TM 5-3810-294-20).

17-6. Forward-Rear Axle and Interaxle Differential Assembly

a. Removal. Refer to paragraph 11-12 and remove forward-rear axle assembly.

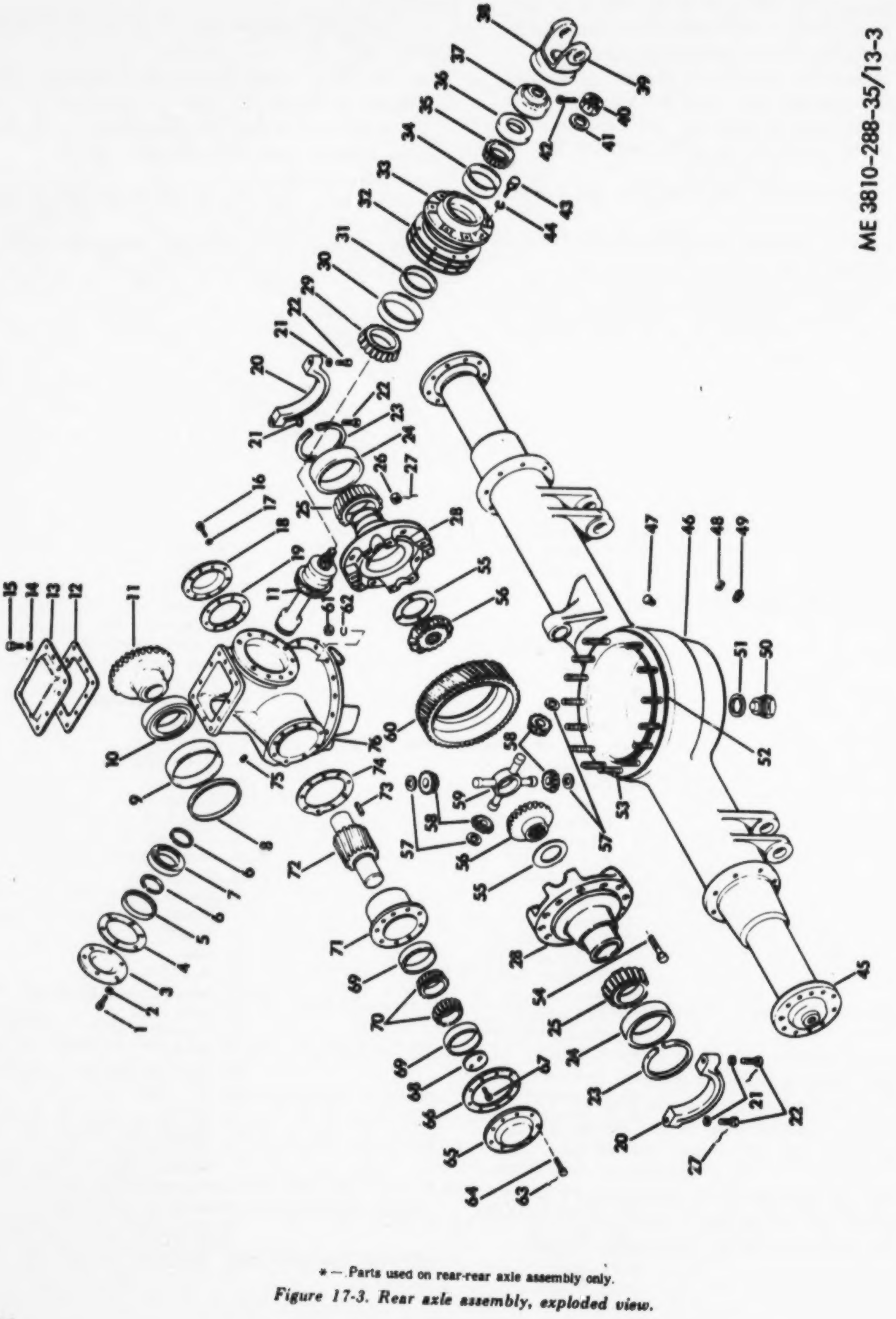
b. Disassembly.

(1) Drain lubricant from forward-rear axle and interaxle differential.

(2) Remove hub and drum assembly (refer to para 17-5).

KEY to fig. 17-3.

*1. Capscrew (6)
*2. Lockwasher (6)
*3. Cover
*4. Gasket
*5. Spacer
*6. Retaining ring (2)
7. Bearing
8. Spacer
9. Sleeve
10. Bearing
*11. Gear set — includes gear and pinion, and through-shaft *
12. Gasket
13. Cover
14. Lockwasher (8)
15. Capscrew (8)
16. Capscrew (8)
17. Lockwasher (8)
18. Cover
19. Gasket
20. Bearing cap (2)
21. Lockwasher (4)
22. Capscrew (4)
23. Retaining ring (2)
24. Bearing cup (2)
25. Bearing (2)
26. Nut (8)
27. Lock wire
28. Case assembly
*29. Bearing
*30. Bearing cup
*31. Spacer (AR)
*32. Shim (AR)
*33. Bearing cage cover
*34. Bearing cup
*35. Bearing
*36. Washer
*37. Seal
*38. Slinger
*39. Yoke
*40. Nut
*41. Washer
*42. Cotter pin
*43. Capscrew (8)
*44. Lockwasher (8)
45. Axle shaft, LH Axle shaft, RH
46. Housing
47. Breather assembly
48. Pipe plug
49. Filler plug
50. Drain plug
51. Gasket
52. Gasket
53. Stud (14)
54. Capscrew (8)
55. Thrust washer (2)
56. Gear (2)
57. Thrust washer (4)
58. Pinion (4)
59. Spider
60. Gear
61. Nut (14)
62. Lockwasher (14)
63. Lock wire
64. Capscrew (6)
65. Cover
66. Shim (AR)
67. Capscrew (3)
68. Washer
69. Bearing cup (2)
70. Bearing (2)
71. Bearing cage
72. Pinion shaft
73. Key
74. Shim (AR)
75. Setscrew
76. Housing


ME 3810-288-35/13-3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76

* — Parts used on rear-rear axle assembly only.

Figure 17-3. Rear axle assembly, exploded view.

(3) Remove nuts (61, fig. 17-3) and lockwashers (62).

(4) Remove drive unit from axle housing.

(5) Remove and disassemble axle differential as follows:

(a) Center punch one carrier housing (76) leg and bearing cap (20) to insure proper reassembly.

(b) Break lock wire (27) and remove capscrews (22), lockwashers (21), and bearing caps (20). Remove retaining ring (23) and bearing cup (24).

(c) Remove differential and gear assembly (25 — 28, and 54 — 60) as a unit.

(d) Center punch halves of case assembly (28) for correct alinement during reassembly.

***(e)* Remove** lock wire (27), nuts (26), and capscrews (54).

(f) Pull up on one half of case assembly (28) and strike gear (60) with a soft mallet to separate case assembly (28).

(g) Disassemble thrust washers (55 and 57), side gears (56), pinions (58), and spider (59).

(h) Remove bearings (25) from case halves with a suitable puller.

(6) Remove capscrews (15), lockwashers (14), top cover (13), and gasket (12).

(7) Remove and disassemble the interaxle differential as follows:

(a) Remove shift housing (48, fig. 17-4) and shift assembly (33) as a unit. Remove gaskets (47).

KEY to fig. 17-4.

1. Cotter pin (2)
2. Nut (2)
3. Washer
4. Yoke
5. Slinger (2)
6. Capscrew (6)
7. Lockwasher (6)
8. Seal (2)
9. Cover
10. Gasket
11. Bearing
12. Shaft
13. Spacer
14. Cover
15. Gasket
16. Retaining ring (2)
17. Bearing
18. Gear set—for illustration purposes only. Same as item 11 of fig. 17-3.
19. Bearing
20. Bearing cup
21. Housing
22. Filler plug
23. Drain plug
24. Lock wire
25. Spacer (AR)
26. Bearing cup
27. Bearing
28. Nut
29. Lock nut
30. Lockwasher
31. Nut
32. Shim (AR)
33. Shift assembly
34. Nut (3)
33. Stud (2)
36. Cotter pin
37. Nut
38. Ball
39. Shift fork
40. Washer
41. Spring
42. Bolt
43. Screw
44. Washer
45. Spring
46. Gasket
47. Gasket (2)
48. Housing
49. Nut
50. Screw
51. Stud
52. Clutch collar
53. Differential case assembly
54. Thrust washer
55. Gear
56. Thrust washer (4)
57. Pinion (4)
58. Spider
59. Gear
60. Thrust washer
61. Nut (12)
62. Bolt (12)
63. Lock wire
64. Cover
65. Lockwasher (8)
66. Capscrew (8)
67. Bearing cup (2)
68. Bearing (2)
69. Spacer (AR)
70. Capscrew (8)
71. Washer
72. Gasket
73. Capscrew (4)

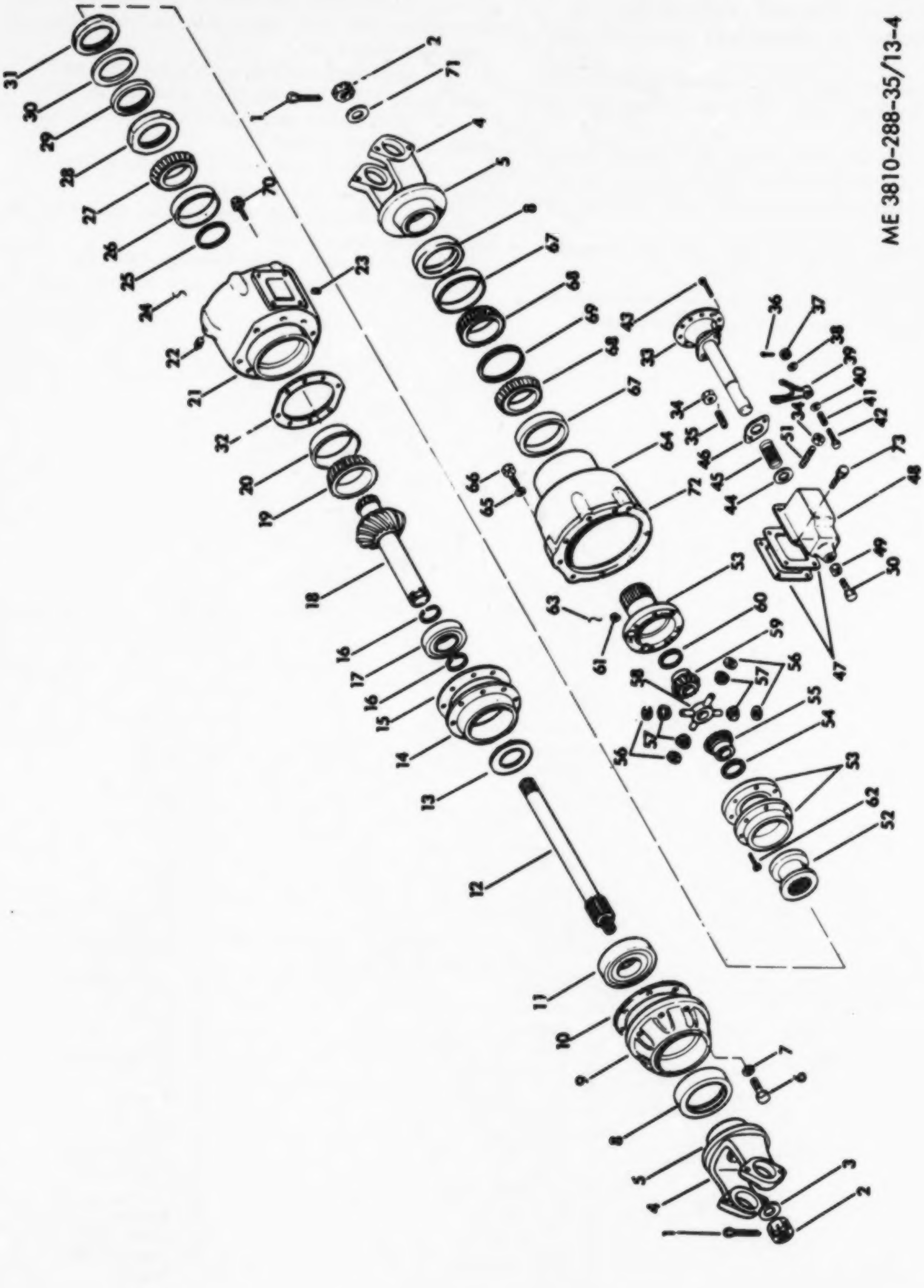

ME 3810-288-35/13-4
31
30
29
28
27
26
25
24
22
21
23
70
1
2
71
4
5
8
67
68
69
68
67
64
72
66
65
32
20
19
18
16
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
43
33
34
35
46
45
44
36
37
38
39
40
34
41
42
51
73
48
49
50
47
53
60
59
63
61
58
57
56
55
54
57
56
53
62
52

Figure 17-4. Interaxle differential, exploded view.

(b) **If necessary, disassemble air shift assembly (33—51) as necessary for replacement of** defective components.

(c) Remove cotter pin (1), nut (2), yoke (4) and slinger (5). Remove slinger (5) from yoke only if replacement is necessary.

(d) Remove cotter pin (1), nut (2), washer (3), yoke (4), and slinger (5) from output end.

(e) Remove capscrews (66) and lockwasher (65), and remove cover (64).

(f) Press case assembly (53) from cover (64). Take care not to damage cover during this disassembly process.

(g) Pull bearing cups (67), bearings (68), and bearing spacer (69) from case assembly (53). Press oil seal (8) from cover (64).

(h) Break lock wire, and remove bolts (62), and nuts (61). Separate case assembly (53). Remove thrust washers (54 and 60), side gears (55 and 59), thrust washers (56) and pinions (57) from spider (58).

(i) Break lock wire and remove capscrews (70), then remove housing (21), and gear (18). Tie shim pack (32) together to aid in reassembly.

(j) Clamp gear (18) in a copper-jawed vise, and remove nut (31), lockwasher (30), lock nut (29), and nut (28).

(k) Remove housing (21) from bearing (19) and gear (18).

(l) Remove bearing (27) and press bearing cups (20 and 26) from housing (21).

(m) Remove bearing spacer (25) and bearing (19) from gear (18). Use a suitable puller tool to remove bearings.

(n) Remove outer retaining ring (16), then press or pull bearing (17) from gear (18). Remove inner retaining ring (16).

(o) Remove capscrews (6), lockwashers (7), cover (9), and gasket (10). Press seal (8) from cover. Remove through-shaft (12) by lightly tapping on input end of shaft with a rubber hammer.

(p) Remove cover (14) and gasket (15); tap spacer (13) from cover.

(q) Remove ball bearing (11) from through-shaft (12) using a suitable puller tool.

(8) Remove capscrews (16, fig. 17-3), lockwashers (17), cover (18), and gasket (19).

(9) Remove lock wire (63), capscrews (64), cover (65), and shims (66). Tie shim pack (66) together to facilitate reassembly.

(10) Break lock wires and remove capscrews (67) and retaining washer (68). Then press on the end of shaft (72) opposite bearing cage (71). Support bearing cage (71) and press bearings (70) and bearing cups (69) from the bearing cage. Remove shims (74) and tie them together to facilitate reassembly.

(11) Remove bearing (10) and spacer (8) from gear (11). Do not remove bearing sleeve (9) unless replacement is necessary.

c. Cleaning, Inspection and Repair.

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all bearings, cups, and cones for pitting, scoring, nicks, or other damage. Replace defective parts.

(3) Inspect all gears and pinions for pitting, broken teeth, or other damage. If it is necessary to replace the pinion through-shaft, or gear (11, fig. 17-3), the entire gear set must be replaced. Also replace differential pinions (58) and side gears (56) in sets if any one of them is defective.

(4) Inspect sleeve (9) I.D. and radial bearing (10) O.D.. Replace sleeve and / or bearing if parts are damaged or if there is more than 0.006 inch clearance between them. The radial bearing must be free to float in the sleeve.

(5) Remove nicks, mars, and burrs from machined surfaces. Use a fine mill file or india stone for this function.

(6) Replace all gaskets and oil seals removed.

(7) Inspect all parts for excessive wear or other damage, and replace defective parts.

d. Reassembly.

(1) Assemble radial bearing (10, fig. 17-3) and sleeve (9), if removed, on gear (11) hub with large radius of bearing inner race toward back of gear.

(2) Install spacer (8) on gear (11) hub against bearing with chamfer of spacer away from bearing.

(3) Coat inside of gear (11) with grease specified in the current LO. Install gear, bearing, and spacer assembly in drive unit sleeve and block in position.

(4) Position housing (76) in press, through-shaft chamber down, with gear (11) supported in suitable sleeve.

(5) Aline key (73) in shaft (72) with keyway in gear (11) hub. Press shaft into gear, bearing, and spacer.

(6) Install two guide pins in housing (76). Position original shim pack (74) on housing. Be sure oil holes in shims are properly alined with oil holes in housing.

(7) Start bearing cage (71) on guide pins. Be sure oil holes are properly alined. Press inner bearing cup (69) into bearing cage (71) until it is seated against the shoulder. Press bearings (70) and remaining bearing cup into bearing cage one at a time in the order shown in figure 17-3.

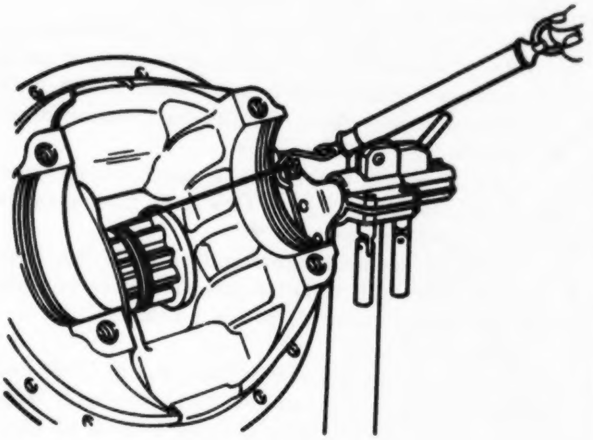
(8) Install retaining washer (68) and capscrews (67). Tighten capscrews to 45 — 60 foot-pounds. Install lock wire.

(9) Install original shim pack (66), cover (65), and capscrews (64). Torque capscrews to 116 — 129 foot-pounds.

(10) Measure shaft **(72)** bearing preload torque. Wrap a strong cord around pinion shaft and pull on horizontal line with pound scale (fig. 17-5). Preload torque should be from 5 to 15 pound-inches. Add shims (66, fig. 17-3) to decrease, or remove shims to increase shaft bearing preload torque.

Note. Preload torque = Pinion Radius x Pounds Pull.

(11) If shaft (72) binds, strike top of gear (11) with a brass bar and recheck bearing preload.



ME 3810-288-35/13-5

Figure 17-5. Measuring cross shaft preload torque.

(12) Install gasket (19), cover (18), lockwashers (17) and capscrews (16). Torque capscrews to 26—29 foot-pounds.

(13) Install inside retainer ring (16, fig. 17-4) onto gear (18) shaft. Coat bearing (17) I.D. and shaft (18) O.D. with grease specified in the current LO.

(14) Press bearing (17) onto gear (18), shaft and install outer retaining ring (16).

(15) Press bearing cups (20 and 26) firmly in place against housing (21) shoulder. Lubricate bearing journals with a few drops of engine oil and press bearing (19) onto gear (18) shaft.

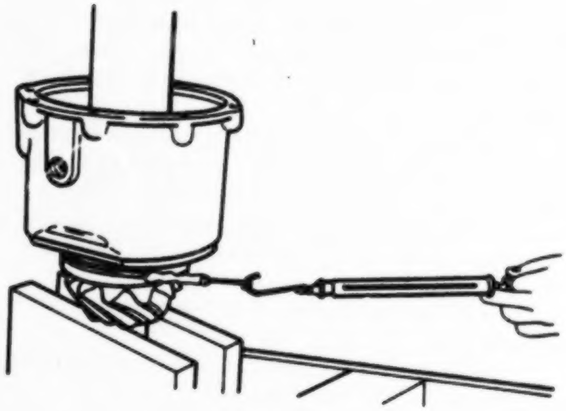
(16) Install original spacer (25) over shaft and against inner bearing (19). Chamfer of spacer must be toward outer bearing or input end.

(17) Position housing (21) and cups (20 and 26) assembly on gear (18). Press bearing (27) over gear (18) shaft and into housing (21) until firmly seated against spacer (25). Rotate housing (21) to assure normal bearing contact.

(18) Measure pinion bearing (19 and 27) preload torque (fig. 17-6). Wrap a strong cord around housing pilot. Install and tighten bearing nut (28) and torque to 1,000—1,200 foot-pounds. At the same time pull on horizontal line with pound scale as shown in figure 17-6. Read rotating pounds pull on scale, not starting pounds pull. When specified nut torque is reached, preload should be within 5-15 pound inches.

Note. Preload Torque = Housing Pilot Radius x Pounds Pull on scale.

(19) Use thinner spacer (25, fig. 17-4) to increase, or a thicker spacer (25) to decrease preload torque.



ME 3810-288-35/13-6

Figure 17-6. Measuring pinion bearing preload torque (forward-rear axle).

(20) Install lock nut (29) and torque to 1,000—1,200 foot-pounds. Recheck bearing preload. Install lockwasher (30) and nut (31). Bend lockwasher (30) over nut (31).

(21) Loosely install two studs in carrier housing to facilitate housing assembly (21) installation. Install shim pack (32) over studs so oil holes are in correct alinement.

(22) Install housing (21) and gear (18) assembly to carrier housing. Carefully tap assembly into place. Install and tighten four equally spaced capscrews (70). Check gear tooth contact (step e. below). Alter shim (74, fig. 17-3) pack under cross shaft bearing cage (71) and shim pack (32, fig. 13-4) under housing (21) to secure correct tooth contact. Remove guide studs and install remaining capscrews (70) and torque to 160—180 foot-pounds. Install lock wire.

e. Tooth Contact and Gear Backlash. Tooth contact may be checked as follows.

(1) Apply a thin coat of lightly oiled red lead with a small brush to both drive and coast sides of a dozen teeth of the gear. When the pinion is rotated the red lead is squeezed from the gear teeth by pressure of the pinion teeth, leaving areas the exact size, shape, and location of the contact. Sharper, better defined areas of contact can be obtained by applying rolling resistance to the gear, providing the gear is not forced out of location during the checking operation.

(2) Use the smallest amount of the lead and oil mixture that will render good impressions. The drier the mixture the better the impressions. Clean the material from the gear and pinion teeth when the operation is completed. Always judge tooth contact by noting pattern on the drive side of the gear teeth. The coast side pattern should be correct when the drive side pattern is correct.

(3) Set backlash to amount specified on gear O.D. Set backlash to 0.005—0.015 inches if amount is not specified.

(4) With adjustments properly made (pinions at correct depth and backlash set at 0.005 — 0.015 inches), the area of contact is centered between the top and bottom of the tooth.

f. Reassembly and Installation of Axle Differential.

(1) Press bearing (25, fig. 17-3) firmly against both case half (28) shoulders. Coat inside of case assembly (28) and all differential parts with rear axle lubricant specified in the current LO.

(2) Assemble one case half and gear (60). Install one thrust washer (55) and one side gear (56) on case half. Then assemble pinions (58) and thrust washers (57) to spider (59) and install in case half. Install other side gear (56) and thrust washer (55).

(3) Note case alinement marks, and assemble opposite case half (28). Install four equally spaced capscrews (54) and nuts (26), and check for free rotation of parts.

(4) Install remaining capscrews (54) and nuts (26). Be sure case assembly (28) is assembled to gear (60) so there is adequate nut clearance. Check clearance in housing (76) before completing assembly.

(5) Torque nuts (26) to 92—102 foot-pounds. Install lock wire (27).

(6) Install bearing cups (24) over bearings (25), and install differential with bearings and cups in carrier housing (76). Center complete assembly between carrier leg grooves.

(7) Temporarily install thin spacers (23) into each carrier leg, making certain there is clearance between bearing cup faces and spacers. Do not install bearing caps (20).

(8) Using a dial indicator, measure end play of differential assembly by moving the assembly back and forth between the spacers.

(9) Remove and measure the thickness of the spacers. Add the total thickness of the two spacers, the end play, plus another 0.017 to 0.022 inches to obtain the total thickness of spacers required to obtain correct bearing preload. Total thickness may be divided between the added thicker spacers. The thicker spacers will replace the thin spacers used to determine bearing preload.

(10) Install one spacer (23) as determined in step (9) above into carrier leg groove. Move differential assembly over so that face of bearing cup (24) is held tightly against spacer (23). Install spacers so that split portion locates in center of bearing cap (20).

(11) Install opposite spacer (23). Install bearing caps (20), lockwashers (21), and capscrews (22). Torque capscrews to 160-180 foot-pounds.

(12) Install gasket (21), top cover (13), lockwashers (14), and capscrews (15). Torque capscrews to 26-29 foot-pounds.

(13) Install gasket (52) over axle housing studs (53); then install drive unit to axle housing (46). Install lockwashers (62) and nuts (61) as drive unit is being lowered into axle housing. There should be 3/16 inch clearance between top of studs (53) and through-shaft chamber. Torque nuts (16) to 180-220 foot-pounds.

(14) Refer to paragraph 17-5 and install hub and drum assembly.

g. Installation. Install front rear axle assembly (para 11-12). Lubricate in accordance with the current LO.

17-7. Rear-Rear Axle Assembly

a. Removal. Remove rear-rear axle assembly (refer to para 11-13).

b. Disassembly. Disassembly procedure for the rear-rear axle assembly is similar to that of the forward-rear axle, therefore many of the following disassembly steps will be referenced to paragraph 17-6. The differences are noted by asterisks (*) in the legend for figure 17-3.

(1) Drain lubricant from rear-rear axle assembly.

(2) Follow disassembly instructions in steps (2) through (6) of paragraph 17-6 *(b)*.

(3) Remove cotter pin (42, fig. 17-3), nut (40), and washer (41). Using a suitable puller, remove yoke (39). Remove slinger (38) from yoke only if replacement is necessary.

(4) Remove capscrews (1), lockwashers (2), cover (3), gasket (4), and bearing spacer (5).

(5) Remove capscrews (43) and lockwashers (44). Remove gear set pinion and through-shaft assembly (11) and bearing cage (33) as a unit. Remove oil seal (37) and washer (36) from bearing

cage (33). Tie shims (32) together and retain for reassembly.

(6) Press bearing cage (33), bearing cups (30 and 34), and bearing (35) from through-shaft (11).

(7) Remove spacer (31) from through-shaft. Press or pull bearing (29) from through-shaft.

(8) Press pinion from through-shaft only if replacement of either part is necessary.

(9) Remove outer retaining ring (6) and press or pull bearing (7) from through-shaft. Remove inner retainer ring (6).

(10) Follow disassembly instructions in steps 8) through (11) of paragraph 17-6 *(b)*.

c. *Cleaning, Inspection, and Repair.* Refer to paragraph 17-6 *(c)*.

d. *Reassembly.*

(1) Perform steps (1) through (12) of paragraph 17-6 *(d)*.

(2) Press bearing cups (30 and 34) into bearing cage (33), until bearing cups are against shoulder.

(3) Coat through-shaft (11) O.D. and bearing (7) I.D. with grease specified in the current LO. Install inner retainer ring (6), then press bearing (7) onto shaft. Install outer retainer ring (6).

(4) If pinion was removed from through-shaft (11) first coat pinion and through-shaft splines with grease specified in the current LO, then press parts firmly together.

(5) Lubricate bearing (29) journal with a few drops of engine oil, and press bearing (29) onto through-shaft (11).

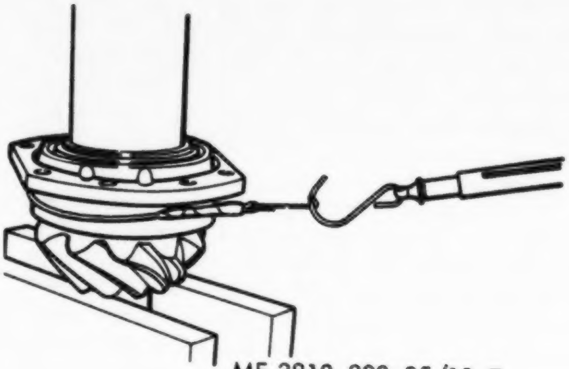
(6) Install original bearing spacer (31) over shaft and against inner bearing (29), with O.D. chamfer toward outer bearing (35).

(7) Install bearing cage and cup assembly (30, 33, and 34) and outer bearing (35) onto through-shaft. Press bearing (35) until it is firmly seated against spacer (31). Rotate bearing cage to assure normal bearing contact.

(8) Measure pinion bearing preload (fig. 17-7) while bearing is being pressed under 9 tons pressure. Wrap strong cord around bearing cage pilot and pull pound scale horizontally as shown. Preload torque should be 5 — 15 inch pounds.

Note. Preload Torque = Bearing Cage Pilot Radius x Pounds Pull.

(9) Use a thinner spacer (31) to increase or a thicker spacer (31) to decrease preload torque.



ME 3810-288-35/13-7

Figure 17-7. Measuring pinion bearing preload torque (rear-rear axle).

(10) Assemble washer (36) and oil seal (37) to bearing cage (33) and through-shaft (11).

(11) Loosely install two guide studs into carrier-to-bearing cage capscrew holes. Position original shim pack (32) over guide studs so oil holes are in correct alinement.

(12) Install pinion and through-shaft (11), and bearing cage (33) assembly into carrier housing (76).

(13) Install and equally space four capscrews (43) and lockwahsers (44). Tighten capscrews.

(14) Check gear set tooth contact (para 13-6 *(e)*).

(15) Remove guide studs and install remaining capscrews (43) and lockwashers (44). Torque capscrews to 82-91 foot-pounds.

(16) Install spacer (5). Apply gasket cement to mating surfaces of cover (3) and carrier housing (76). Install new gasket (4), then install cover (3), lockwashers (2), and capscrews (1). Torque capscrews to 26-29 foot-pounds.

(17) Install slinger (38), yoke (39), washer (41), and nut (40). Torque nut to 300 to 400 foot-pounds. Install cotter pin (42).

(18) Refer to paragraph 17-6 *(g)* and reassemble the axle differential.

(19) Fill rear-rear axle assembly with lubricant specified in the current LO.

e. *Installation.* Install rear-rear axle assembly (para 11-13).

CHAPTER 18

REPAIR OF CARRIER BRAKES

Section I. REPAIR OF FRONT BRAKES

18-1. Description

The front brakes are air actuated two-shoe brakes. Each brake shoe has a one-piece liner of uniform thickness.

18-2. Front Service Brakes

a. Removal and Disassembly.

(1) Remove wheels (refer to TM 5-3810-294-20).

(2) Remove screws (1, fig. 16-6), lockwashers (2), plate (3), packing (4), washer (5), and retaining ring (6).

(3) Remove nuts (8), lockwashers (9), flange (7), gasket (10), and packing (11).

(4) Remove nut (12), washer (13), lockwasher (14), and bearing adjusting nut (15).

(5) Remove outer wheel bearing (16).

(6) Remove hub (21) and drum (22) as an assembly. Remove bearing (33). Bearing cups (17 and 31) are press fit into the hub and should not be removed unless absolutely necessary.

(7) Remove spring (26) from brake shoes (27 and 28). Remove bolts (24) and retainer (25), and slide brake shoes from anchor pins (32).

(8) Disconnect air brake chamber (102) from slack adjuster (96).

(9) Remove retaining ring (98), slack adjuster (96), and spacers (95) from camshaft (29). Tap camshaft from flange (59). Do not remove bushing (39) unless replacement is necessary. Bushing is press fit.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts except brake linings with an approved cleaning solvent. Wipe parts dry, but allow bearings to air dry.

(2) Inspect bearings and bearing cups for pitting, scoring, or other damage. Replace defective bearings or bearing cups.

(3) Inspect brake linings for excessive wear. Lining worn to within 1/16 inch of rivet heads should be replaced.

(4) Inspect brake drum for cracks, scoring, or other damage and replace if necessary.

(5) Inspect all parts for excessive wear or other damage, and replace defective parts.

c. Reassembly and Installation.

(1) Install camshaft (29, fig. 16-6).

(2) Install bushing (39), slack adjuster (96), and retaining ring (98).

(3) Connect air brake chamber push rod to slack adjuster.

(4) Slide brake shoes (28 and 27) over anchor pins (32). Install brake shoe retainer (25) and bolts (24), then install brake shoe return spring.

(5) Pack bearing (33) with grease and slide it onto spindle (37). If bearing cups were removed, press replacement cups into hub (21).

(6) Install hub (21) and drum (22) as a unit. Pack outer wheel bearing (16) with grease and slide it onto spindle.

(7) Install bearing adjusting nut (15). Turn adjusting nut up tight, then back off one-quarter turn. Spin wheel in both directions and check for free rotation without excessive end play. Readjust nut as necessary.

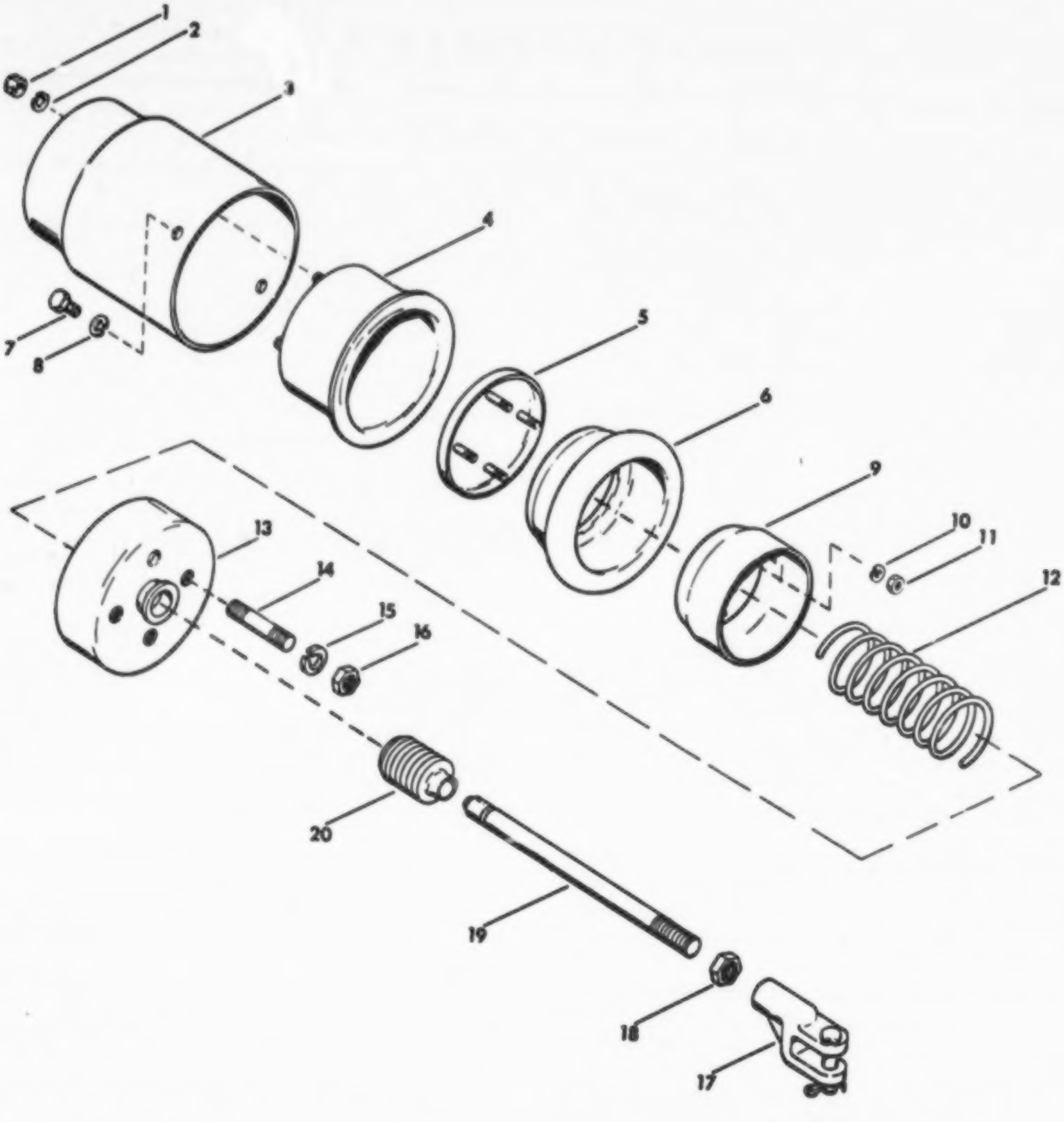
(8) Install lockwasher (14), washer (13), and nut (12). Tighten nut securely.

(9) Install packing (11), gasket (10), flange (7), lockwashers (9), and nuts (8). Tighten nuts securely.

(10) Install retaining ring (6), washer (5), plate (3), lockwashers (2) and screws (1).

(11) Install wheels (refer to TM 5-3810-294-20).

(12) Adjust brakes (refer to TM 5-3810-294-20).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
20
19
18
17

ME 3810-288-35/14-1

1. Nut (4)
2. Lockwasher (4)
3. Body
4. Outer clamp
5. Inner clamp
6. Diaphragm
7. Capscrew (4)
8. Lockwasher (4)
9. Diaphragm guide
10. Lockwasher (4)
11. Nut (4)
12. Spring
13. Cover
14. Stud (2)
15. Lockwasher (2)
16. Nut (2)
17. Yoke
18. Lock nut
19. Push rod
20. Dust seal boot

Figure 18-1. Front brake chamber, exploded view.

18-3. Front Brake Chamber

a. Removal. Remove front brake chamber (refer to TM 5-3810-294-20).

b. Disassembly. Refer to figure 18-1 and disassemble front brake chamber.

c. Cleaning, Inspection, and Repair.

(1) Clean non-metal parts with a clean cloth. Clean metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for serviceability and replace defective parts.

d. Reassembly. Refer to figure 18-1 and reassemble front air brake chamber.

e. Installation. Install front brake chamber (refer to TM 5-3810-294-20).

Section II. REPAIR OF REAR BRAKES

18-4. Description

The rear brakes are air actuated two-shoe brakes. Each brake shoe has two tapered block liners. The brake chamber mounts on a bracket bolted to the brake spider. Therefore, the brake is completely unit mounted.

18-5. Rear Service Brakes

a. Removal and Disassembly.

(1) Remove rear wheels (refer to TM 5-3810-294-20).

(2) Remove hub and drum assembly (refer to para 17-5).

(3) Remove shoe return spring (19, fig. 18-2).

1. Rivet (5)
2. Cover (2)
3. Worm
4. Welch plug
5. Bushing
6. Set screw
7. Worm shaft
8. Shaft lock
9. Spring
10. Worm gear
11. Slack adjuster body
12. Dust shield assembly
13. Capscrew (6)
14. Retaining ring (4)
15. Felt washer (4)
16. Retainer (4)
17. Pin (2)
18. Sleeve (4)
19. Spring
20. Brake shoe assembly (2) — Includes items 21 and 22.
21. Brake lining (2)
22. Rivet (20)
23. Roller (2)
24. Set screw (2)
25. Pin (2)
26. Cam
27. Retaining ring
28. Washer
29. Washer
30. Bushing
31. Lock wire
32. Screw (2)
33. Spider
34. Gasket
35. Washer (4)
36. Capscrew (4)
37. Bracket
38. Nut (2)
39. Lockwasher (2)
40. Brake chamber
41. Bushing
42. Felt washer
43. Washer
44. Washer (thin)
45. Washer (thick)
46. Retainer

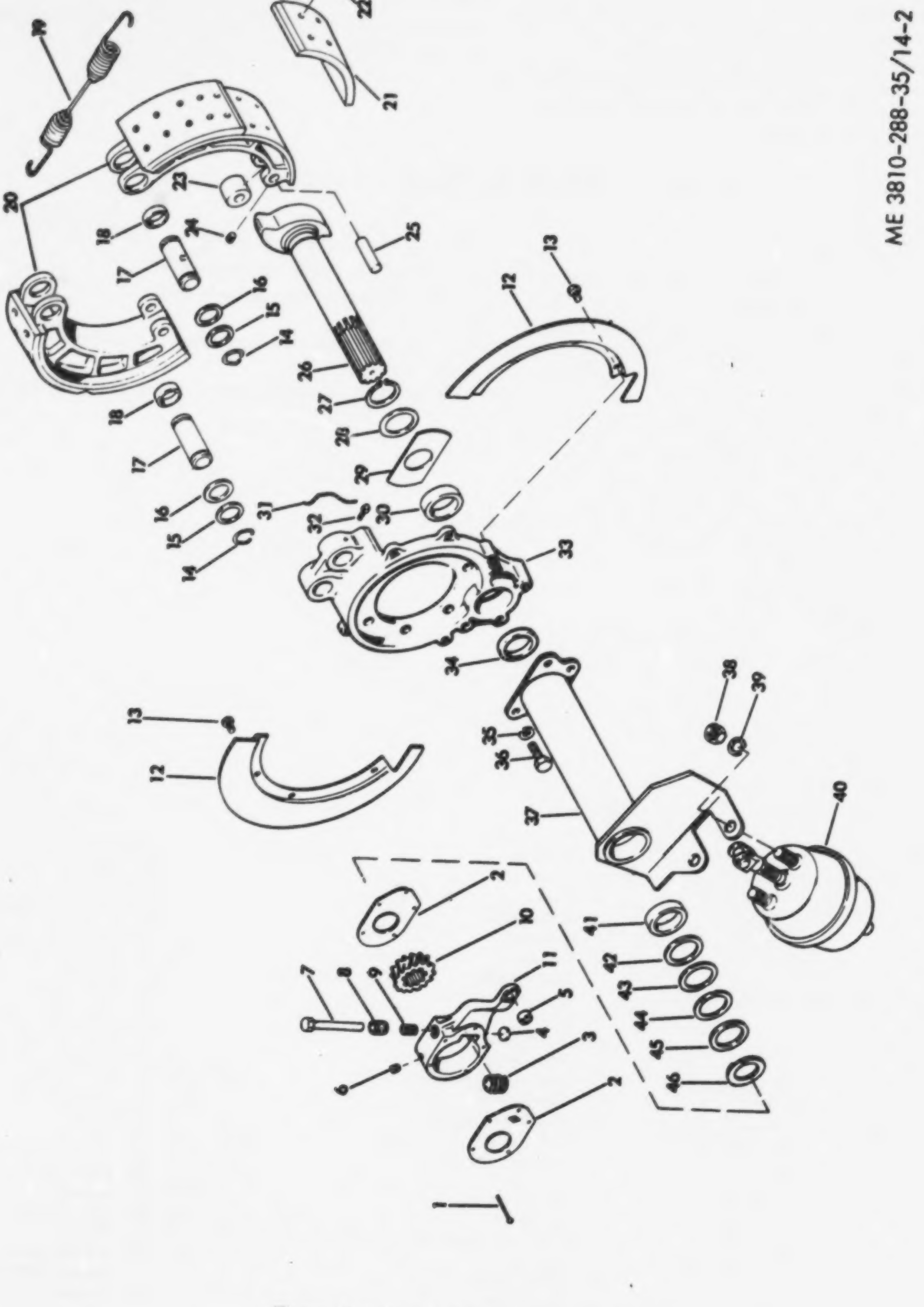

ME 3810-288-35/14-2
1
2
2
3
4
5
6
7
8
9
10
11
12
12
13
13
14
14
15
15
16
16
17
17
18
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46

Figure 18-2. Rear brake assembly, exploded view.

(4) Remove retaining rings (14), felt washers (15), and retainers (16) from anchor pins (17).

(5) Cut lock wire (31) and remove lock screws (32).

(6) Remove anchor pins (17), sleeve (18), and brake shoe assembly (20).

(7) Remove shoe rollers (23) and pins (25).

(8) Disconnect slack adjuster body (11) from brake chamber (40).

(9) Remove retainer (46), then remove slack adjuster (1 thru 11). Remove cam (26).

(10) Remove bushing (30) from spider (33) only if replacement is necessary.

(11) If other brake components must be replaced remove, disassemble, reassemble, and install parts as shown in figure 18-2.

b. Cleaning, Inspection and Repair.

(1) Clean all parts except brake linings with an approved cleaning solvent and dry thoroughly.

(2) Inspect brake linings for excessive wear. Lining worn to within 1 / 16 inch of rivet heads should be replaced.

(3) Inspect all parts for excessive wear or other damage, and replace defective parts.

c. Reassembly and Installation.

(1) Install new bushing (30, fig. 18-2) if required.

(2) If any washers were removed from cam and spider during disassembly, install same washers as shown.

(3) Install cam (26) with assembled washers through spider (33) and bracket (37).

(4) Install slack adjuster (1—11) to cam, then install retainer (46).

(5) Connect slack adjuster to brake chamber (40).

(6) Install rollers (23) and roller pins (25).

(7) Install bushings (18) and anchor pins (17) to brake spider(33). Secure anchor pins with screws (32), then insert lock wire through heads of screws.

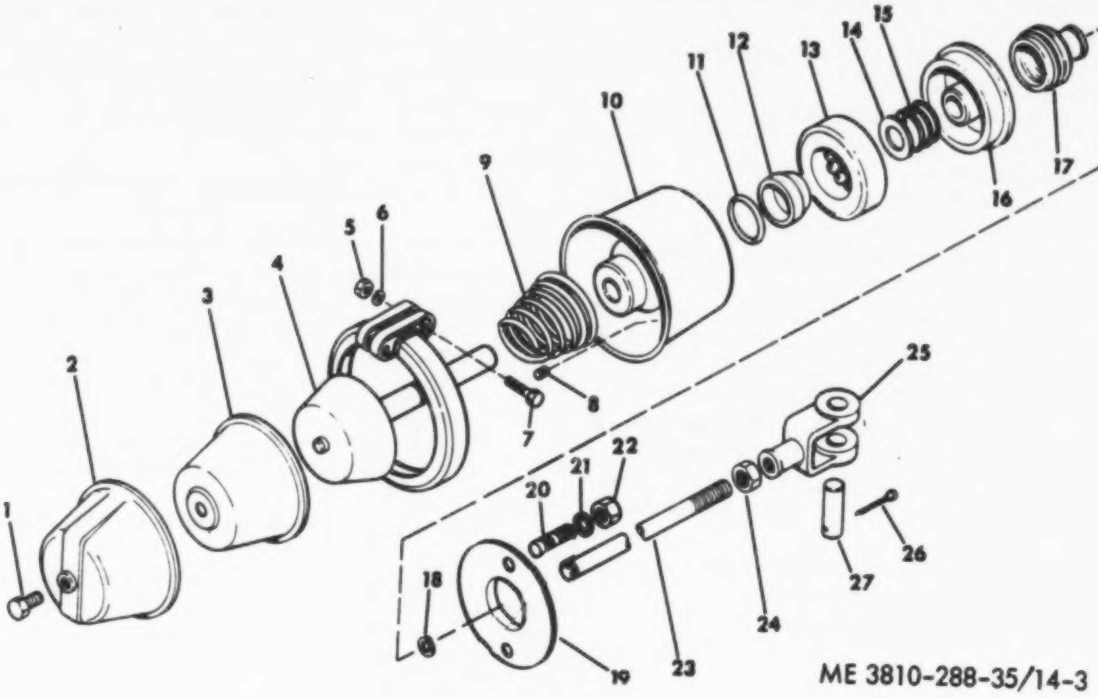
(8) Position brake shoes (20) over anchor pins (17), and install retainers (16), felt washers (15), and retaining rings (14).

(9) Install brake shoe return spring (19).

(10) Install hub and drum assembly (refer to para 17-5).

(11) Install rear wheels (refer to TM 5-3810-294-20).

(12) Adjust rear brakes (refer to TM 5-3810-294-20).



1. Pipe plug
2. Pressure plate
3. Diaphragm
4. Push plate and shaft assembly
5. Nut (2)
6. Clamping ring
7. Screw (2)
8. Pipe plug
9. Spring
10. Non-pressure plate
11. Piston grommet
12. Piston
13. Collar assembly
14. Spring seat washer
15. Roller spring
16. Lock cap
17. Boot
18. Retaining ring
19. Splash guard
20. T-bolt (2)
21. Lockwasher (2)
22. Nut (2)
23. Push rod
24. Lock nut
25. Yoke
26. Yoke pin
27. Cotter pin

Figure 18-3. Rear brake chamber, exploded view.

18-6. Rear Brake Chambers

a. Removal. Remove the rear brake chambers (refer to TM 5-3810-294-20).

b. Disassembly. Refer to figure 18-3 and disassemble the rear brake chambers as follows:

(1) Clean the exterior of the brake chamber and match mark it in such a way so it can be reassembled in the same manner.

(2) Remove yoke (25), lock nut (24), boot (17) and splash guard (19).

(3) Remove nuts (5) and bolts (7). Spread clamping ring (6) just enough to remove pressure plate (2) and non-pressure plate (10). It may be necessary to use a soft mallet to break the clamping ring loose. If the ring is to be reused, caution should be taken against bending it out of shape.

(4) Remove diaphragm (3) from pressure plate (2).

(5) Connect an air supply line to the locking port on non-pressure plate (10). Place push plate and shaft assembly (4) against a work bench. With one hand, press down on non-pressure plate (10) and at the same time apply air to the locking port. As the shaft is unlocked, slowly release the non-pressure plate and remove the push plate and shaft assembly with push rod (23) and return spring (9).

(6) Hold lock cap (16) against roller spring (15), and remove the capscrews holding the lock

cap. Remove the lock cap, roller spring and spring seat washer (14).

(7) Remove the rollers from collar assembly (13). Carefully apply air to the locking port to assist in removal of collar assembly (13), piston (12), and piston grommet (11).

(8) Push rod (23) should not be removed unless it is damaged. If the rod is removed, it must be replaced. To remove the rod, place a heavy washer over the rod and against shaft assembly (4). Then position a spacer and a second washer over the rod and beneath yoke lock nut (24). Turning the lock nut with a wrench will push the shaft assembly from the rod.

(9) T-bolts (20) can be pressed out of non-pressure plate (10) if replacement is necessary.

c. *Cleaning, Inspection, and Repair.*

(1) Clean nonmetal parts with a clean cloth. Clean metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for serviceability and replace defective parts.

d. *Reassembly*. Refer to figure 18-3 and reassemble the rear brake chambers as follows:

(1) Lubricate piston (12) and collar assembly (13) bores, shaft (4), piston grommet (11) and piston (12) with GAA.

(2) Place piston grommet (11) in the piston bore in non-pressure plate (10). Then position the piston with the smooth end down against the grommet.

(3) Place collar assembly (13) in non-pressure plate (10) with the large tapered I.D. of the collar up. Be sure the roller in the collar assembly are properly seated in the groove formed by the piston and collar assembly.

(4) Place roller spring seal washer (14) on top of the rollers. Position roller spring on washer with small end against the washer. Position lock cap (16) on the roller spring. Press the lock cap down and install the capscrews. Tighten the capscrews evenly.

(5) Turn non-pressure plate (10) over and install return spring (9) in the plate with the large end down.

(6) Position push plate and shaft assembly (4) over return spring (9) and press down so that the shaft moves through the lock. The lock should hold the shaft in position against the return spring. If not, check the assembly.

(7) Install diaphragm (3), pressure plate (2), and clamping ring (6). Install bolts (7) and nuts (5).

(8) Install boot (17). Place splash guard (19) over boot (17) and T-bolts (20).

(9) If push rod (23) was removed, install a new rod. Position retaining ring (18) in the push rod slot, then position the rod in shaft assembly (4) and tap the rod into the shaft assembly.

e. *Installation.*Install rear brake chambers (refer to TM 5-3810-294-20).

CHAPTER 19

REPAIR OF WIRING HARNESSES AND CARRIER FRAME

Section I. REPAIR OF WIRING HARNESSES

19-1. Description

There are three major wiring harnesses that distribute the electrical power throughout the carrier electrical system: (1) Cab wiring harness, (2) frame wiring harness, and (3) engine wiring harness. Battery cables and jumper wires are not considered parts of wiring harnesses. Complete wiring harnesses should not be removed unless many electrical leads have been damaged. Refer to TM 5-3810-294-20 for wiring harness repair.

19-2. Removal

a. Refer to schematic diagram in TM 5-3810-294-20 to locate termination points of electrical leads. Using an ohmmeter to determine electrical lead continuity will facilitate harness removal.

b. Remove clamps which secure wiring harness and remove harness from carriers.

19-3. Installation

a. Neatly position and route wiring harness.

b. Install cable clamps to hold wiring harness in place.

c. Refer to TM 5-3810-294-20 and properly connect electrical leads. Use an ohmmeter to continuity check electrical leads, thus ensuring correct lead connection.

Section II. REPAIR OF CARRIER FRAME

19-4. Description

The welded frame is machined for the roller path upon which the crane (revolving frame) rides. It carries the revolving frame and supports the cab assembly, engine, transmission, transfer case, and their connecting units. The frame is carried on the front axle assembly and tandem rear axle assembly.

19-5. Removal

Refer to other chapters and sections of this manual and TM 5-3810-294-20 to remove parts and assemblies necessary to allow frame repair or replacement. Frame replacement should not be done unless damage is beyond repair.

19-6. Cleaning, Inspection, and Repair

a. Clean frame with live steam.

b. Inspect for cracks or breaks in the frame. Repair cracks or breaks by welding. Be sure strength of weld is sufficient to support weight of carrier part and / or assembly. Refer to chapter 2 for special welding instructions.

c. Replace frame if damage is beyond weld repair.

19-7. Installation

Refer to other chapters and sections of this manual and TM 5-3810-294-20 to reinstall parts and assemblies removed for frame repair or replacement.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand portable fire extinguishers for Army Users.

A-2. Lubrication

LO 5-3810-294-12	Lubrication Order.
C 91001L	Fuels, Lubricants, Oils and Waxes.

A-3. Paint

TM 9-213	Painting instructions for Field use.

A-4. Radio Suppression

TM 11-483	Radio Interference suppression.

A-5. Maintenance

TM 5-3810-294-10	Operator / Crew Maintenance Manual
TM 5-3810-294-20	Organizational Maintenance Manual
TM 5-3810-294-20P	Organization Maintenance Repair Parts & Special Tools List
TM 5-3810-294-34P	Direct Support Maintenance and General Support Maintenance Repair Parts & Special Tools List.
TM 9-1870-1	Care and maintenance of pneumatic tires.
TB 750-651	Use of antifreeze solutions and cleaning compounds in engine cooling systems.
TM 38-750	The Army Maintenance Management System
TM 9-6140-200-15	Operator, Organizational, Field & Depot Maintenance, Storage Batteries, Lead Acid Type.
TB 385-101	Safety Use of cranes, crane shovels.

PART ONE

CRANE INDEX

A

	Paragraph	Page
Alternator:		
Cleaning	3-4	3-2
Description	3-1	3-1
Disassembly	3-3	3-1
Inspection and repair	3-5	3-2
Reassembly and installation	3-6	3-2
Removal	3-2	3-1
Approximate Weights	1-4*b* (5)	1-2
Automatic Planetary Boom Hoist Pawls:		
Description	6-4	6-3
Replacement	6-5	6-4

B

	Paragraph	Page
Battery Cables, Suppression Leads, and Wiring Harness:		
Inspection and repair of battery cables	8-7	8-3
Repair	8-8	8-3
Boom Hoist Shaft:		
Description	5-21	5-13
Inspection and repair	5-23	5-13
Reassembly and installation	5-24	5-13
Removal and disassembly	5-22	5-16
Brake Band Repair	2-8	2-7

C

	Paragraph	Page
Cab Assembly:		
Installation	2-11*b*	2-20
Removal	2-11*a*	2-20
Camshaft, Crankshaft, Piston and Rods:		
Cleaning	4-35	4-11
Description	4-32	4-9
Disassembly	4-34	4-11
Inspection	4-36	4-11
Reassembly and installation	4-38	4-12
Removal	4-33	4-9
Repair and replacement	4-37	4-12
Carburetor:		
Cleaning	3-22	3-10
Description	3-19	3-8
Disassembly	3-21	3-8
Inspection and repair	3-23	3-10
Reassembly and installation	4-24	4-7
Removal	3-20	3-8
Control Stand Assembly:		
Installation	2-23*a*	2-37
Removal	2-23*b*	2-37
Crane, Dragline and Clamshell Boom:		
Repair	9-12	9-5
Replacement	9-13	9-6
Crane Engine:		
Description	4-1	4-1
Removal	4-2	4-1
Removal of accessories	4-3	4-1
Crane Propeller Shaft:		
Description	5-9	5-10
Disassembly	5-11	5-10
Inspection and repair	5-12	5-10
Installation	5-14	5-11
Reassembly	5-13	5-11
Removal	5-10	5-10
Crane Transmission and Clutch:		
Clutch Disassembly	5-3	5-5
Clutch Inspection and repair	5-4	5-5
Clutch reassembly	5-5	5-5
Descritpion	5-1	5-1
Removal of transmission / clutch assembly	5-2	5-3
Transmission disassembly	5-6	5-6
Transmission inspection and Repair	5-7	5-9
Transmission reassembly	5-8	5-9
Crane Worm Shaft:		
Description	5-15	5-11
Disassembly	5-17	5-11
Inspection and repair	5-18	5-13
Installation	5-20	5-13
Reassembly	5-19	5-13
Removal	5-16	5-11
Cylinder Head, Rocker Arm and Valves:		
Cleaning	4-7	4-3
Description	4-4	4-1
Disassembly	4-6	4-3
Inspection	4-8	4-3
Reassembly and installation	4-10	4-3
Removal of head	4-5	4-1
Repair and replacement	4-9	4-3

D

	Paragraph	Page
Data, Tabulated:		
Carrier	1-4	1-1
Crane	1-4	1-1
Description	1-3	1-1
Dimensions and Transportation Data	1-4*b* (4)	1-2
Distributor:		
Cleaning	3-16	3-7
Description	3-13	3-6
Disassembly	3-15	3-6
Inspection	3-17	3-7
Reassembly and installation	3-18	3-7
Removal	3-14	3-6

E

	Paragraph	Page
Engine Control Panel:		
Description	7-10	7-5
Removal	7-11	7-5
Repair procedures	7-12	7-5
Engine Crankcase:		
Cleaning	4-41	4-13
Description	4-39	4-12
Disassembly	4-40	4-12
Inspection	4-42	4-13
Repair and replacement	4-43	4-13
Engine and Transmission Assembly:		
Installation	2-13*a*	2-20
Removal	2-13*b*	2-21

CRANE INDEX—Continued

	Paragraph	Page
F		
Fairlead Assembly:		
Cleaning, Inspection and replacement.	9-19	9-6
Description	9-17	9-6
Removal	9-18	9-6
Flywheel and Housing:		
Cleaning	4-21	4-7
Description	4-18	4-6
Disassembly	4-20	4-7
Inspection	4-22	4-7
Reassembly and installation	4-24	4-7
Removal	4-19	4-6
Repair and replacement	4-23	4-7
Forms and Records	1-2	1-1
Front Drumshaft:		
Description	5-31	5-19
Disassembly	5-33	5-19
Inspection and repair	5-34	5-21
Installation	5-36	5-22
Reassembly	5-35	5-21
Removal	5-32	5-19
G		
Gantry:		
Description	9-1	9-1
Repair procedures	9-2	9-1
Gear Cover:		
Cleaning	4-14	4-5
Description	4-11	4-4
Disassembly	4-13	4-5
Inspection	4-15	4-5
Reassembly and installation	4-17	4-5
Removal	4-12	4-4
Repair and replacment	4-16	4-5
General Disassembly Instructions	2-5	2-7
General Inspection Instructions	2-6	2-7
General Reassembly Instructions	2-7	2-7
Governor		
Cleaning	3-28	3-13
Description	3-25	3-12
Disassembly	3-27	3-12
Inspection and repair	3-29	3-13
Reassembly and installation	3-30	3-14
Removal	3-26	3-12
H		
Hand Operated Pawls and Swing Lock Assembly:		
Adjustment	6-3	6-3
Description	6-1	6-1
Replacement	6-2	6-3
Hook Block:		
Description	9-3	9-3
Disassembly	9-5	9-3
Inspection and repair	9-6	9-5
Reassembly	9-7	9-5
Removal	9-4	9-3
Hook Roller:		
Cleaning, Inspection and repair	8-4	8-2
Description	8-1	8-1
Disassembly	8-3	8-1
Installation	8-6	8-2
Reassembly	8-5	8-2
Removal	8-2	8-1
Horizontal Swing Shaft:		
Description	5-43	5-25
Disassembly	5-45	5-25
Inspection and repair	5-46	5-26
Installation	5-48	5-27
Reassembly	5-47	5-26
Removal	5-44	5-25
Hydraulic Schematic	1-4*b* (12)	1-2
M		
Major Components and Auxiliaries Removal and installation	2-10	2-10
Master Cylinder		
Description	7-5	7-3
Disassembly	7-7	7-3
Inspection, cleaning and repair	7-8	7-4
Reassembly	7-9	7-5
Removal	7-6	7-3
O		
Oil Pan and Oil Pump		
Cleaning	4-28	4-9
Description	4-25	4-7
Disassembly	4-27	4-9
Inspection	4-29	4-9
Reassembly and installation	4-31	4-9
Removal	4-26	4-7
Repair and replacement	4-30	4-9
Operator's Seat:		
Removal	7-13	7-5
Repair procedures	7-14	7-5
R		
Radiator		
Cleaning, Inspection and Repair	3-39	3-15
Description	3-37	3-15
Installation	3-40	3-15
Removal	3-38	3-15
Rated Capacities	1-4*b* (7)	1-2
Rear Drumshaft		
Description	5-25	5-14
Disassembly	5-27	5-14
Inspection and repair	5-28	5-18
Installation	5-30	5-18
Reassembly	5-29	5-18
Removal	5-26	5-14
Repair and Replacement Standards	1-4*b*(14)	1-3
Reversing Shaft:		
Description	5-37	5-22
Disassembly	5-39	5-22
Inspection and repair	5-40	5-24
Installation	5-42	5-25
Reassembly	5-41	5-25
Removal	5-38	5-22
S		
Scope	1-1	1-1
Sheaves and Boom Rollers:		
Cleaning, inspection and Repair	9-10	9-5
Description	9-9	9-5
Installation	9-11	9-5
Shovel and Backhoe Attachments:		
Repair of shovel dipper stick	9-14	9-6
Repair of shovel and backhoe attachments	9-15	9-6

CRANE INDEX—Continued

	Paragraph	Page
S—Continued		
Shovel and Backhoe Attachments—Continued:		
Replacement	9-16	9-6
Special Tools and Equipment	2-1	2-1
Specially Designed (fabricated) Tools and Equipment	2-2	2-1
Speeds (full throttle and full load)	1-4*b* (6)	1-2
Starting Motor:		
Cleaning	3-10	3-5
Description	3-7	3-3
Disassembly	3-9	3-3
Inspection and repair	3-11	3-5
Reassembly and installation	3-12	3-5
Removal	3-8	3-3
Swing Brake Control Stand:		
Cleaning, inspection and repair	7-3	7-3
Description	7-1	7-1
Disassembly	7-2	7-1
Reassembly	7-4	7-3
Swing Brake Shaft:		
Description	5-49	5-27
Repair Procedures	5-50	5-27
Swing Lock:		
Cleaning, Inspection and Repair	6-8	6-5
Description	6-6	6-4
Disassembly	6-7	6-4
Reassembly	6-9	6-5
T		
Torque Values	1-4	1-1
Transmission / Clutch Assembly:		
Installation	2-14*c*	2-22
Removal	2-14*b*	2-22
Troubleshooting	2-4	2-1
V		
Vertical Swing Shaft:		
Description	5-51	5-27
Repair Procedures	5-52	5-27
W		
Water Pump:		
Cleaning	3-34	3-14
Description	3-31	3-14
Disassembly	3-33	3-14
Inspection and repair	3-35	3-14
Reassembly and installation	3-36	3-14
Removal	3-32	3-14
Welding Procedures for "T-1" Steel:		
Electrode selection	2-9*b*	2-7
Heat	2-9*c*	2-8
Welding procedures	2-9*d*	2-9
Worm Shaft Assembly:		
Installation	2-19*b*	2-30
Removal	2-19*a*	2-29

PART TWO

CARRIER INDEX

	Paragraph	Page
A		
Air Compressor		
Cleaning	12-24	12-12
Description	12-21	12-10
Disassembly	12-23	12-10
Inspection and repair	12-25	12-12
Reassembly and installation	12-26	12-12
Removal	12-22	12-10
Alternator	12-1	12-1
C		
Cab Assembly	11-7	11-1
Carburetor:		
Cleaning	12-12	12-7
Description	12-9	12-4
Disassembly	12-11	12-4
Inspection and repair	12-13	12-7
Reassembly and installation	12-14	12-7
Removal	12-10	12-4
Carrier Frame:		
Cleaning, Inspection and Repair	19-6	19-1
Description	19-4	19-1
Installation	19-7	19-1
Removal	19-5	19-1
Clutch Assembly:		
Cleaning, inspection and repair	14-15	14-16
Clutch adjustment	14-18	14-16
Description	14-12	14-14
Disassembly	14-14	14-14
Installation	14-17	14-16
Reassembly	14-16	14-16
Release bearing adjustment	14-19	14-17
Removal	14-13	14-14
Clutch Control:		
Adjustment	14-5	14-3
Cleaning, inspection and repair	14-3	14-3
Description	14-1	14-1
Reassembly and installation	14-4	14-3
Removal and disassembly	14-2	14-1
Crankcase		
Cleaning	13-41	13-11
Description	13-39	13-10
Disassembly	13-40	13-10
Inspection	13-42	13-11
Reassembly and installation	13-44	13-12
Repair and replacement	13-43	13-12
Crankshaft, Camshaft and Piston Rings		
Cleaning	13-35	13-9
Description	13-32	13-8
Disassembly	13-34	13-9
Inspection	13-36	13-9
Reassembly and installation	13-38	13-10
Removal	13-33	13-8
Repair and replacement	13-37	13-9
Cylinder Head, Rocker Arms and Valves:		
Cleaning	13-7	13-3
Description	13-4	13-1
Disassembly	13-6	13-3
Inspection	13-8	13-3
Reassembly and installation	13-10	13-4
Removal	13-5	13-1
Repair and replacement	13-9	13-3
D		
Data, Tabulated	10-4	10-1
Description	10-3	10-1
Distributor:		
Cleaning	12-6	12-3
Description	12-3	12-1
Disassembly	12-5	12-1
Inspection and Repair	12-7	12-3
Reassembly and installation	12-8	12-3
Removal	12-4	12-1
E		
Engine:		
Description	13-1	13-1
Preparation for repair	13-3	13-1
Removal	13-2	13-1
F		
Flywheel:		
Cleaning	13-21	13-6
Description	13-18	13-6
Disassembly	13-20	13-6
Inspection	13-22	13-6
Reassembly and installation	13-24	13-6
Removal	13-19	13-6
Repair and replacement	13-23	13-6
Forms and Records	10-2	10-1
Forward-Rear Axle and Interaxle Differential Assembly		
Cleaning, inspection and repair	17-6 *(c)*	17-9
Disassembly	17-6 *(b)*	17-5
Installation	17-6 *(g)*	17-11
Reassembly	17-6 *(d)*	17-9
Reassembly and installation of axle		
Differential	17-6 *(f)*	17-11
Removal	17-6 *(a)*	17-5
Tooth contact and gear backlash	17-6 *(e)*	17-10
Front Axle Assembly:		
Cleaning	16-16	16-13
Disassembly	16-15	16-10
Inspection and repair	16-17	16-13
Installation	16-19	16-14
Reassembly	16-18	16-14
Removal	16-14	16-10
Front Axle Differential Assembly		
Cleaning	16-10	16-9
Description	16-7	16-7
Disassembly	16-9	16-7
Inspection and repair	16-11	16-9
Installation	16-13	16-10.
Reassembly	16-12	16-9
Removal	16-8	16-7
Front Axle and Spring Assembly:		
Installation	11-11*b*	11-10
Removal	11-11*a*	11-9

CARRIER INDEX—Continued

	Paragraph	Page
F—Continued		
Front Brakes	18-1	18-1
Front Brake Chamber:		
Cleaning, inspection and repair	18-3 *(c)*	18-3
Disassembly	18-3 *(b)*	18-3
Installation	18-3 *(e)*	18-3
Reassembly	18-3 *(d)*	18-3
Removal	18-3 *(a)*	18-3
Front Service Brakes:		
Cleaning, inspection and repair	18-2 *(b)*	18-1
Reassembly and installation	18-2 *(c)*	18-1
Removal and disassembly	18-2 *(a)*	18-1
G		
Gear Cover:		
Cleaning	13-14	13-5
Description	13-11	13-4
Desassembly	13-13	13-5
Inspection	13-15	13-5
Reassembly and installation	13-17	13-6
Removal	13-12	13-4
Repair and replacement	13-16	13-5
H		
Hub and Drum Assembly:		
Cleaning, inspection and repair	17-5 *(b)*	17-4
Reassembly and installation	17-5 *(c)*	17-4
Removal and disassembly	17-5 *(a)*	17-3
Hydraulic Pump		
Cleaning	12-30	12-14
Description	12-27	12-13
Disassembly	12-29	12-13
Inspection and repair	12-31	12-14
Reassembly and installation	12-32	12-14
Removal	12-28	12-13
M		
Maintenance, General	11-5	11-1
O		
Oil Pan and Oil Pump:		
Cleaning	13-28	13-7
Description	13-25	13-7
Disassembly	13-27	13-7
Inspection	13-29	13-7
Reassembly and installation	13-31	13-7
Removal	13-26	13-7
Repair and replacement	13-30	13-7
P		
Propeller Shafts:		
Cleaning, inspection and repair	15-4	15-3
Description	15-1	15-1
Disassembly	15-3	15-1
Installation	15-6	15-3
Reassembly	15-5	15-3
Removal	15-2	15-1
R		
Radiator	12-33	12-14
Rear Brakes	18-4	18-13
Rear Brake Chambers:		
Cleaning, inspection and repair	18-6 *(c)*	18-7
Disassembly	18-6 *(b)*	18-6
Installation	18-6 *(e)*	18-7
Reassembly	18-6 *(d)*	18-7
Removal	18-6 *(a)*	18-6
Rear-rear Axle Assembly:		
Cleaning, Inspection and Repair	17-7 *(c)*	17-12
Disassembly	17-7 *(b)*	17-11
Installation	17-7 *(e)*	17-12
Reassembly	17-7 *(d)*	17-12
Removal	17-7 *(a)*	17-11
Rear Service Brakes:		
Cleaning, inspection and repair	18-5 *(b)*	18-5
Reassembly and installation	18-5 *(c)*	18-5
Removal and disassembly	18-5 *(a)*	18-3
Rear Suspension Assembly:		
Description	17-1	17-1
Equalizer beam assembly	17-3	17-3
Torque rod assembly	17-2	17-1
S		
Scope	10-1	10-1
Specially Designed (Fabricated) Tools and Equipment	11-2	11-1
Special Tools and Equipment	11-1	11-1
Starting Motor	12-2	12-1
Steering Gear:		
Cleaning	16-4	16-5
Description	16-1	16-1
Disassembly	16-3	16-3
Inspection and repair	16-5	16-5
Reassembly and installation	16-6	16-5
Removal	16-2	16-1
Transfer Case:		
Cleaning, inspection and repair	15-10	15-5
Description	15-7	15-3
Disassembly	15-9	15-3
Installation	15-12	15-7
Reassembly	15-11	15-5
Removal	15-8	15-3
Transmission Assembly:		
Cleaning, inspection and repair	14-9	14-10
Description	14-6	14-5
Disassembly	14-8	14-9
Installation	14-11	14-14
Reassembly	14-10	14-10
Removal	14-7	14-3
Troubleshooting	11-4	11-1
W		
Water Pump:		
Cleaning	12-18	12-9
Description	12-15	12-8
Disassembly	12-17	12-8
Inspection and repair	12-19	12-9
Reassembly and installation	12-20	12-9
Removal	12-16	12-8
Wiring Harness:		
Description	19-1	19-1
Installation	19-3	19-1
Removal	19-2	19-1

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25, Section II (qty rqr block No. 359) direct and general support maintenance requirements for Cranes: Truck Mounted.

☆U.S. GOVERNMENT PRINTING OFFICE : 1989 O - 242-451 (5106)